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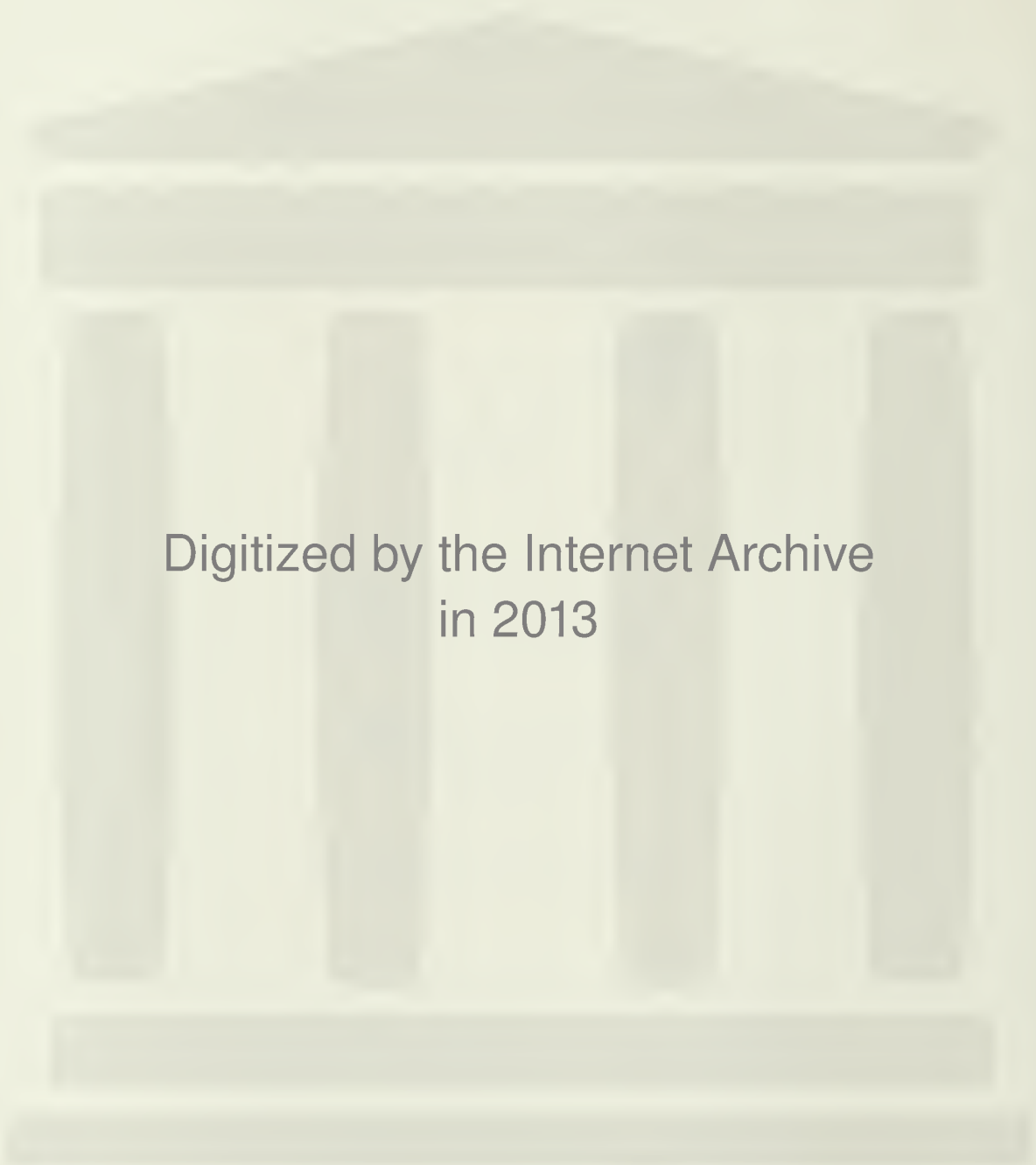
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CALTRAIN SAN FRANCISCO
DOWNTOWN EXTENSION PROJECT
CONCEPTUAL DESIGN AND DRAFT EIS/EIR

Design Options Screening Report

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CalTrain San Francisco Downtown Extension Project

DESIGN OPTIONS SCREENING REPORT

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DESIGN OPTIONS SCREENING REPORT

1.1 INTRODUCTION

In March 1994, the JPB selected two "build" alternatives for evaluation in the CalTrain Downtown San Francisco Extension Project. These alternatives were: an underground terminal at Market and Beale Streets, the Locally Preferred Alternative (LPA); and a terminal at the site of the existing Transbay Terminal.

The purpose of this report is to provide the public and decision-makers with the information they need to narrow the design options for each of the two build alternatives being analyzed in the Draft Environmental Impact Statement/Draft Environmental Impact Report (DEIS/DEIR). The JPB will use this information, along with public input, to select a specific design option for each decision. By mixing and matching design options, the JPB will be able to define the "optimum" Market/Beale and Transbay Terminal Site Alternatives which will be carried forward for further refinement and environmental analysis in the DEIS/DEIR.

This report presents a brief description of the alternatives, project background/related studies, summary of the methodology used to develop the information and analysis presented in the report, and the trade-offs associated with each of the eight key decisions.

1.2 KEY DESIGN OPTION DECISIONS

The following eight decisions must be made in order to refine the alternatives for analysis in the DEIS/DEIR:

- **Decision #1: Which East/West Alignment and Short or Long Tunnel Option Should Be Selected?** Four options being considered are: 1) an alignment on Townsend Street that has a portal east of Fifth/Townsend (short tunnel option); 2) an alignment along Townsend that has a portal south of Berry/Seventh (long tunnel option); 3) an alignment along King Street that has a portal east of Sixth/King (short tunnel option); or 4) an alignment on King Street that has a portal south of Berry/Seventh (long tunnel option);

- **Decision #2: Which North/South Alignment and Construction Technique Should Be Selected for the Market/Beale Alternative?** Two potential north/south alignments are being considered for the Market/Beale Alternative. They are: 1) cut-and-cover construction from Townsend and The Embarcadero to Market/Beale; or 2) mined tunnel construction from Third/Townsend to Market/Beale.

- **Decision #3: Which North/South Alignment and Construction Technique Should Be Selected for the Transbay Terminal Site Alternative?** Two potential north/

south alignments are being considered for the Transbay Terminal Site Alternative. They are: 1) a short mined tunnel/cut-and-cover from Brannan Street/Colin P. Kelly Street to the Transbay Terminal site; or 2) a long mined tunnel from Third/ Townsend to the Transbay Terminal site.

- **Decision #4: Which Market/Beale Terminal Configuration Option Should Be Selected?** Three underground terminal configurations are being considered for the Market/Beale terminal: 1) three-level underground terminal with four tracks terminating at Market Street; 2) two-level underground terminal with two tracks terminating at Market Street and two tracks terminating at Mission Street; and 3) a two-level underground terminal with four tracks terminating at Mission Street.

- **Decision #5: Which Transbay Terminal Site Terminal Configuration Option Should Be Selected?** Two terminal design options are being considered for the Transbay Terminal site. They are: 1) an aerial (second level) station at the Transbay Terminal site; or 2) an underground station at the Transbay Terminal site.

- **Decision #6: Should the Market/Beale Alternative or the Transbay Terminal Site Alternative Be Selected?** CalTrain could be extended to a downtown San Francisco Terminal Station located either under Beale Street at Market Street or at the existing Transbay Terminal site (with or without a new bus terminal).

- **Decision #7: Which Locomotive Propulsion and Ventilation System Option Should Be Selected?** Four propulsion/ventilation system options are being considered. They are: 1) "clean" diesel; 2) liquefied natural gas; 3) electric; or 4) dual-mode (diesel and electric).

- **Decision #8: Where Should a New CalTrain Storage Yard Be Located?** Two potential locations for train storage are being considered. They are: 1) under and adjacent to the I-280 viaduct north of 16th Street in Mission Bay; or 2) near the former Bayshore Yard in Brisbane.

For each decision, this report will provide a comparison of engineering and architectural design opportunities/constraints; capital and operating/maintenance cost estimates; major adverse and beneficial community and environmental impacts; and differences in projected ridership, as appropriate (refer to Section 2.0).

1.3 PROJECT DESCRIPTION

Extending passenger train service directly into downtown San Francisco has been the subject of debate for over a century. Current passenger train service, called the Peninsula Commute Service (or more commonly, CalTrain), ends at Fourth and Townsend Streets in San Francisco, more than 1.5 miles from the downtown core. The CalTrain San Francisco Downtown Extension Project would allow riders to reach down-

town San Francisco from the Peninsula without transferring to other modes of travel, and would provide convenient transfers to the San Francisco Muni Metro, BART, and other regional transit providers that serve downtown San Francisco.

CalTrain service currently extends 77 miles from Gilroy north to Fourth and Townsend Streets. The proposed project would extend this service to a new downtown San Francisco terminal. Three alternatives -- "No Build", Market/Beale Terminal, and Transbay Terminal Site -- are being considered for the CalTrain San Francisco Downtown Extension Project in accordance with the Joint Powers Board (JPB) resolution No. 1994-8.

The "No Build" Alternative retains the existing CalTrain system, including the San Francisco terminal station at Fourth and Townsend streets, and incorporates programmed (funded) improvements to the system as identified in the *CalTrain Short Range Transit Plan FY 1995/96 to FY 2004/05*. Additionally, related transit and road improvements, particularly those in the project area (Figure 1), are elements of the "No Build" Alternative.

The two "build" alternatives would extend the CalTrain alignment to a new downtown San Francisco terminal station either at Market/Beale or at the site of the existing Transbay Terminal (Figure 2). Both alternatives assume that the existing CalTrain terminal and track area would be cleared to allow development of the property, owned by Catellus Corporation, according to the San Francisco Mission Bay Plan (1990).

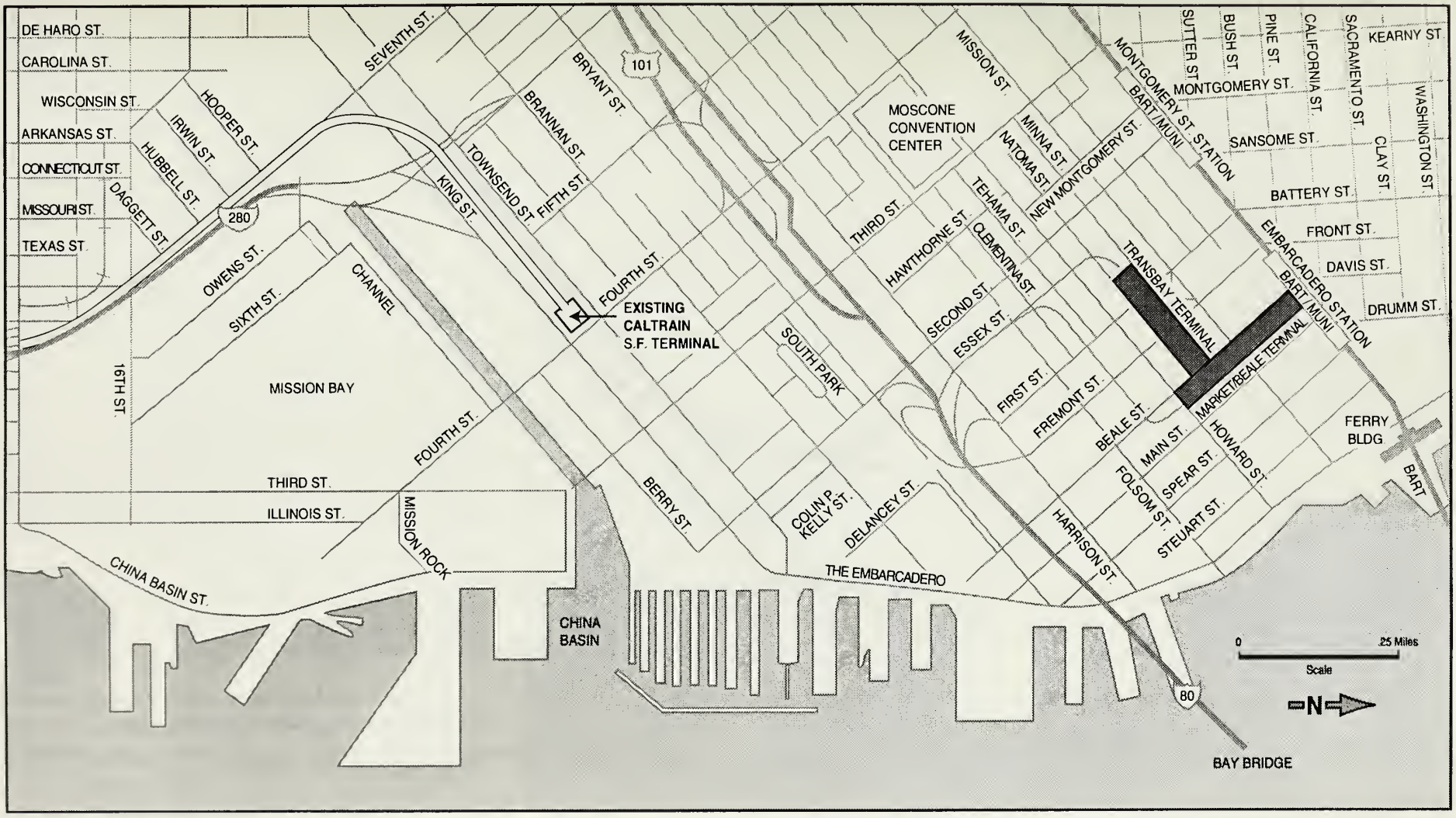

FIGURE 1
PROJECT AREA

CALTRAIN SAN FRANCISCO
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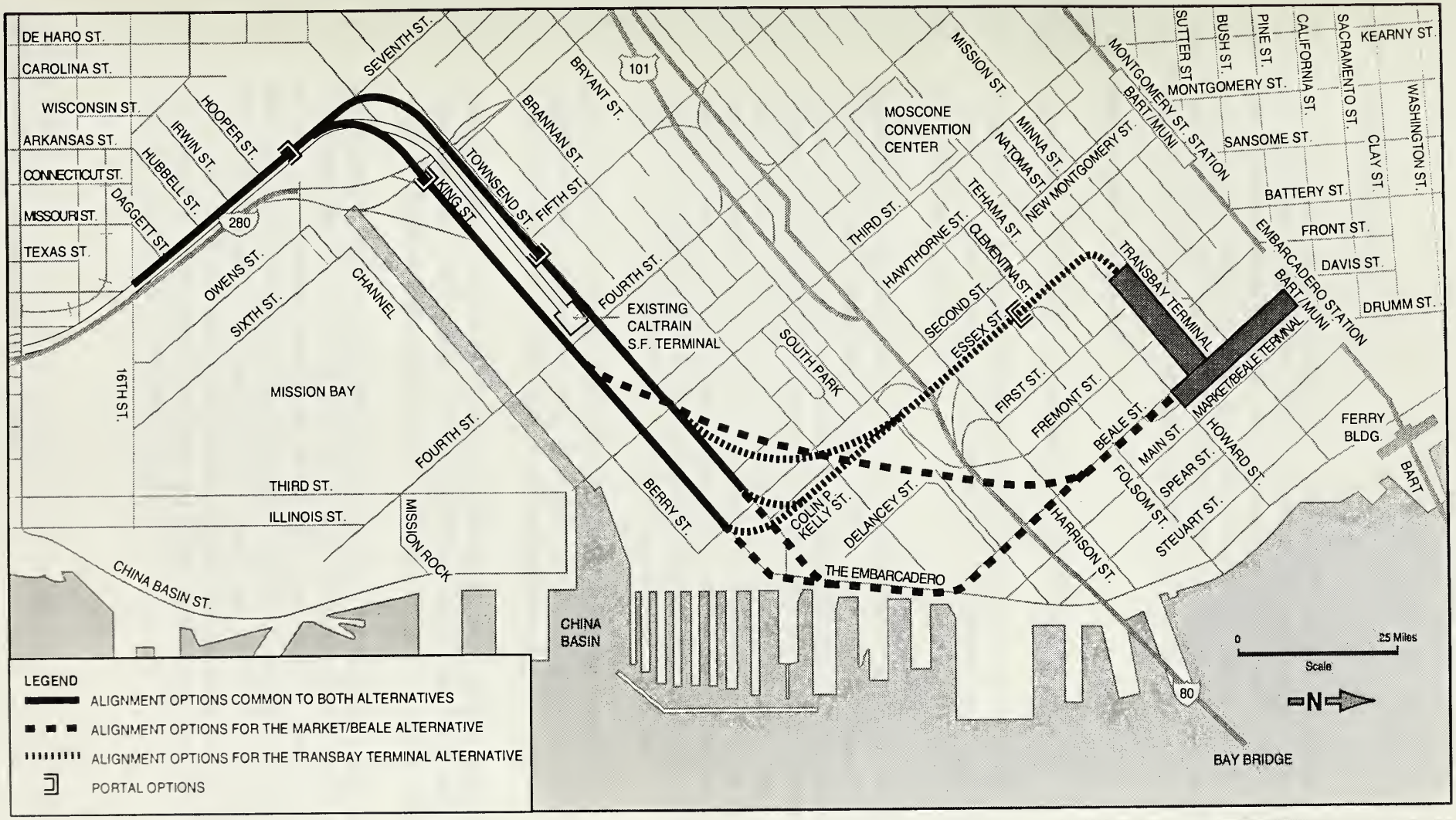

FIGURE 2

MARKET/BEALE AND TRANSBAY TERMINAL SITE ALTERNATIVES: ALIGNMENT OPTIONS

CALTRAIN SAN FRANCISCO DOWNTOWN EXTENSION PROJECT

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1.4 METHODOLOGY

The information and analysis presented in this report are the culmination of a public scoping process that began many years ago and is still continuing. The report builds upon many previous studies, a substantial amount of public input, and new technical studies. The methodology used for screening the design options is therefore a combination of public input, coordination with other agencies, especially the City and County of San Francisco, preliminary engineering, and technical studies.

1.4.1 Public Input/Coordination

Public input and coordination has included the following activities:

- Issuance of a Notice of Preparation and a Notice of Intent to inform and solicit input from public agencies and the public. Comments received helped to identify the eight key decision areas.

- Sponsoring Public Workshops and Open Houses in San Francisco on June 21, 1995 (11:00am-1:30pm and 6:30pm-9:00pm) and in San Carlos on June 29, 1995 (7:00pm-9:00pm). Approximately 150 people attended these workshops. As a direct result of public and agency input, the JPB has revised and reconsidered several aspects of the project including: 1) dropping Brannan Street as a possible east-west alignment; 2) agreeing to study the option of a long tunnel portal at Seventh/Berry; 3) dropping the proposal to remodel the Transbay Terminal in favor of a proposal to construct a new facility on the same site; and 4) studying a direct tunnel from Third Street to the Transbay Terminal site.

- Conducting one-on-one interviews with over 40 key stakeholders to identify significant issues and concerns. The interviews contributed to the JPB's actions listed above and the identification of the eight key decision areas.

- Distributing two issues of the project newsletter with mail-in comment inserts to approximately 4,000 people. A telephone hotline is also in operation. Public input from these two sources have contributed to the screening effort thus far.

- Coordinating with the City and County of San Francisco and Caltrans on the Transbay Terminal Area Study. The study will determine whether to upgrade the existing bus terminal to current seismic, fire, and safety codes or to demolish it and build a replacement transit terminal on the existing site or between Main and Beale Streets north of Folsom Street. Since one of the CalTrain project alternatives involves the Transbay Terminal site, the two projects are being closely coordinated. The project managers of each respective project is on the technical advisory committee of the other project.

- Working with the project's Technical Advisory Committee, which consists of representatives from MTC, the City and County of San Francisco, Santa Clara County Transportation Agency, FTA and Caltrans to review and evaluate technical information, consider issues, and make recommendations to the JPB.

- Presenting monthly project status reports to the JPB, the San Mateo County Transportation Authority, and the San Mateo County Transit District. These board meetings are publicly noticed and the public is invited to comment on project issues and reports. Public comments have been taken into consideration in the screening process.

- Making presentations to various agencies that have an interest in the project.

1.4.2 Preliminary Engineering/Technical Studies

The following preliminary technical reports serve as the basis for the information and evaluation in this report:

- Geotechnical Site Investigations
- Geotechnical Engineering Recommendations
- Transbay Terminal Structural Analysis
- Ridership Forecasting Methodology and Assumptions
- Capital Cost Methodology and Assumptions
- Terminal Track and Platform Analysis
- Locomotive Propulsion Technologies and Tunnel Ventilation/Fire Safety
- Utilities Inventory and Relocation/Reinforcement
- Rough, Order-of-Magnitude Capital Cost Estimates
- Design Options Screening Capital Cost Estimates
- Operations and Maintenance Cost Methodology
- Preliminary Operating and Maintenance Cost Estimates

An environmental scan was also performed to identify potentially significant issues.

1.4.3 Review of the Design Options Screening Report

The Design Options Screening Report will be presented to the JPB at the October board meeting. After presentation to the JPB, the report will be presented to the public and other interested policy boards (e.g. San Francisco Board of Supervisors, San Mateo County Transportation Authority, SamTrans, San Francisco Planning Commission, San Francisco Redevelopment Agency, San Francisco Public Transportation Commission, and Transbay Terminal Area Policy, Technical and Citizens Advisory Committees). Comments received from the public and policy boards will be summarized and included with a staff recommendation for the December 1995 JPB meeting.

1.4.4 Selection of Design Options

At the December 1995 board meeting, the JPB will select specific design options for each alternative and adopt detailed alternatives for complete environmental analysis in the DEIS/DEIR.

1.5 RELATED STUDIES

There are several studies that are closely related to the CalTrain San Francisco Downtown Extension Study. The City of San Francisco is currently conducting the Transbay Terminal Area Study and there have been a whole series of previous studies done regarding the downtown CalTrain extension. These are outlined below.

1.5.1 Transbay Terminal Area Study

The Transbay Terminal, which is owned by Caltrans, is located between Mission, First. Natoma, and Fremont Streets with ramps that sweep east and west from the Terminal to form a large loop connection to the Bay Bridge. The Terminal and its adjoining ramp system were completed in 1939 as part of the construction of the Bay Bridge. It was designed to accommodate East Bay interurban rail service, the "Key System", which ended in 1958.

AC Transit bus service replaced the rail service, and the Terminal was remodeled to accommodate buses. AC Transit and Greyhound now use the Terminal extensively, with more limited use by ten additional transit operators, including among others, the Gray Line, Golden Gate Transit, Muni, and SamTrans.

Following the Loma Prieta earthquake in 1989, the Office of State Architect conducted studies of the Terminal for Caltrans, concluding that the building needed substantial upgrades to meet current seismic and other fire and safety codes.

In December 1992, San Francisco Mayor Frank Jordan sent a letter to James van Loben Sels, Director of Caltrans, asking the state to consider removing the building and replacing it with a smaller facility more appropriately designed to serve the functions of a bus terminal. The request noted the major capital costs for Caltrans to bring the building up to code and discussed the potential for Caltrans involvement in joint development. In 1993, a number of East Bay cities passed resolutions calling for retention of the Transbay Terminal as the region's primary public bus transit hub. The resolutions relied on MTC's *Bay Crossing Study* (1991), which concluded that the most cost-efficient means to meet future transbay travel demand is through expansion of existing transbay bus service.

In 1994, the City and County of San Francisco reached an accord with Caltrans to study the reconstruction or replacement of the terminal at its current site or the relocation of the terminal to the vacant Caltrans land between Main and Beale Streets north of Folsom Street. The Transbay Terminal Area Study was authorized at the time that the

JPB initiated engineering and environmental work for the CalTrain San Francisco Downtown Extension Project. Since the JPB project includes alternatives for the existing Transbay Terminal site and the potential bus terminal site at Market/Beale, coordination between the JPB, the City, Caltrans, and other agencies involved in the Transbay Terminal Area Study has been on-going.

1.5.2 Previous CalTrain Downtown Extension Studies

Several studies have evaluated options for locating a CalTrain station in downtown San Francisco. Among the earlier studies was the 1975 *Peninsula Transit Alternatives Project (PENTAP)*, which recommended several actions including public acquisition of the Southern Pacific (SP) right-of-way and relocation of the Fourth and Townsend station to the downtown core.

In 1984, Caltrans conducted the *San Francisco Terminal Relocation Study*, which recommended a below grade alignment from I-280 and Sixth Street to the Transbay Terminal area. This study predicted that the extension would attract some 30,000 passenger boardings at a new Transbay Terminal station alone.

In 1987, the JPB sponsored the *Interim Upgrade Study*, which recommended a two-track subway extension to an underground station near the Transbay Terminal. This study classified the extension as "the single most important improvement that can be made to the Peninsula commuter line at the present time."

The JPB requested and received authorization in 1989 from the Urban Mass Transportation Administration (UMTA), now the Federal Transit Administration (FTA), to prepare an Alternatives Analysis and Draft Environmental Impact Statement (AA/DEIS) for the project. A series of public meetings and JPB agenda items provided the public with the opportunity to discuss alternatives and identify environmental issues and possible mitigation measures to be addressed in the AA/DEIS. Comments from public meetings along with an initial screening of alternatives led to the three alternatives that were identified for inclusion in the AA/DEIS. A draft AA/DEIS was developed in 1991, but FTA did not approve public circulation of the draft due to a lack of funding commitments for the approximately 75% local share of the project cost.

The project was revived in late 1993 when the JPB joined with the Metropolitan Transportation Commission (MTC) to identify ways to reduce costs and again review federal, state, and local funds to finance a less costly alternative(s). This study evaluated nine project alternatives. Following public review, the JPB passed a resolution (No. 1994-8) that identified Alternative 8B (electrified service extended to a terminal at Market and Beale Streets) as the Locally Preferred Alternative. The resolution also designated Alternative 3B (electrified service extended to the Transbay Terminal) as an additional alternative to be carried forward for conceptual engineering and environmental analysis in the next phase.

2.0 SCREENING OF DESIGN OPTIONS

This section presents a summary of the preliminary ridership projections, the capital and operating cost estimates, and the trade-offs among the design options being considered for the CalTrain San Francisco Downtown Extension Project.

2.1 RIDERSHIP PROJECTIONS SUMMARY

Preliminary 2010 ridership projections were developed for the No Build, Market/Beale, and Transbay Terminal Site Alternatives. The projections were based on the existing output from the MTC Regional Transportation Plan model forecasts prepared in 1994. To make the regional model more relevant for the CalTrain San Francisco Downtown Extension Project, manual modifications were made using the San Mateo Countywide model to account for: 1) changes in configuration of connections between CalTrain, BART, and the Light Rail System planned for San Francisco International Airport; 2) no parking capacity constraints at Peninsula CalTrain Stations; 3) updated 1994 demographic information; and 4) increased CalTrain midday service. The results are subject to further refinement and modification.

The projections reflect two future CalTrain service scenarios, 60 weekday trains and 86 weekday trains. The increase to 86 weekday trains represents doubling midday service. In addition, the MTC forecasts assumed a 10 percent reduction in CalTrain travel times. Proposed changes in San Francisco's Mission Bay Plan and the potential use of land freed by the removal of the Terminal Separator ramps in downtown San Francisco were not factored into the MTC model assumptions.

The preliminary results indicate that for the 60-weekday train scenario in 2010, 12,500 daily boardings and alightings would occur in the No Build Alternative (Fourth and Townsend Station). This level of ridership is essentially the same as exists today. Year 2010 ridership is projected to increase to 19,900 daily boarding and alightings if CalTrain were extended to the Transbay Terminal (see Table 1). Similarly, if CalTrain were extended to a terminal at Market/Beale, Year 2010 ridership is projected at 21,400 boardings and alightings. For the 86-weekday train scenario, the projections increase to 12,800 for the No Build; 23,100 for the Market/Beale terminal; and 21,500 for the Transbay Terminal site.

TABLE 1: PRELIMINARY RIDERSHIP FORECASTS SAN FRANCISCO DOWNTOWN STATION

	Yr 1995 (Existing)	Yr 2010 (60 Trains/Day)	Yr 2010 (86 Trains/Day)
No Build	12,000	12,500	12,800
Market/Beale	-	21,400	23,100
Transbay Terminal	-	19,900	21,500

Source: Korve Engineering/MTC (Based on MTC 1994 RTP Travel Model Forecasts)

NOTE: Forecasts are subject to further refinement and modifications

A complementary study of pedestrian access from the Market/Beale terminal found that CalTrain commuters have destinations scattered north and south of Market. A slight travel time advantage could be gained by a two-level staggered underground station design (tracks terminating at Market and Mission Streets) over the other two Market/Beale Terminal design options because of numerous station access points along Beale from Market to Folsom Streets. However, the pedestrian access study shows that this advantage is very small and is unlikely to impact ridership significantly.

The projections also indicate that, with full build-out of the 1990 Mission Bay Plan, 10,000 boardings and alightings would occur at an intermediate CalTrain station at Mission Bay. Combined with the ridership volumes projected for the Transbay Terminal or Market/Beale sites, CalTrain would need to accommodate 7,200 peak-hour, peak-direction passengers and 1,800 peak-hour, reverse direction passengers. To meet this demand, CalTrain would need about 115 gallery cars, including 14 percent spares. This number is about 25 more cars than is currently in the fleet plus cars that are now on order.

2.2 CAPITAL COST SUMMARY

A summary of capital cost estimates is presented on Table 2. Cost estimates were determined by calculating the capital costs of ten "basic" CalTrain extension alternatives, which all assume the Townsend Street short tunnel alignment, "clean" diesel propulsion, and a train storage yard at 16th/Owens in Mission Bay. The "base" cost estimates all incorporate the need for 25 additional gallery cars to accommodate increased 2010 ridership demand for the Market/Beale and Transbay Terminal Site Alternatives. The additional capital costs for a new bus terminal and ramps presented in Table 2 are preliminary figures (within 10-20 percent level of accuracy). The bus costs are being developed as part of the City and County of San Francisco's Transbay Terminal Area Study, to be published in mid-October 1995.

Once the "base" capital costs have been established for the "primary" Market/Beale terminal alternative (three terminal station configurations and cut-and-cover vs mined tunnel alignment options) and for the "primary" Transbay Terminal site terminal alternative (two terminal station configurations and short-mined vs long-mined tunnel alignment options), then the cost additions (or cost savings, as the case may be) of other design options can be easily added to these base capital costs. For example, full-system electrification would cost an additional $210 million more than all of the "base" alternative cost estimates; extending the subway in Mission Bay from Fifth and Townsend to Seventh and Berry would cost an additional $93 million; and utilizing King Street instead of Townsend Street for the east-west alignment would cost $28-35 million more for the short-tunnel design option and $15 million less for the long-tunnel design option.

The capital cost estimates indicate that the Transbay Terminal Site Alternative design options would be consistently less expensive than the Market/Beale Alternative design options. Not including the bus terminal and ramp costs, the least expensive design option for the Transbay Terminal Site Alternative is the cut-and-cover/short mined tunnel alignment with an aerial station (approximately $470 million). An underground station at

TABLE 2: CAPITAL COST ESTIMATES[1],[2],[3][4]

	Market/Beale Alternative						Transbay Terminal Site Alternative			
	Three-Level Underground Station at Market		Two-Level Underground Station Staggered between Market and Mission		Two-Level Underground Station at Mission		Aerial Station		Underground Station	
COST ELEMENTS	Cut-and-Cover Alignment	Mined Tunnel Alignment	Cut-and-Cover Alignment	Mined Tunnel Alignment	Cut-and-Cover Alignment	Mined Tunnel Alignment	Short Mined Tunnel Alignment	Long Mined Tunnel Alignment	Short Mined Tunnel Alignment	Long Mined Tunnel Alignment
CalTrain Terminal	$115,280	$117,070	$ 99,266	$ 99,266	$ 95,197	$ 95,197	$ 60,775	$ 60,775	$ 82,382	$ 82,382
CalTrain Extension	223,827	213,597	150,771	152,943	137,005	138,784	125,544	133,789	138,645	146,890
Sitework & Utilities	43,891	39,026	43,467	38,853	35,199	30,701	27,439	24,196	29,585	26,342
CalTrain System Elements	24,327	23,431	22,623	22,211	22,522	21,926	22,173	22,066	22,173	22,066
CalTrain Equipment Needs	47,875	47,875	47,875	47,875	47,875	47,875	47,875	47,875	47,875	47,875
Right-of-Way & Easements	13,166	17,109	13,166	17,109	6,166	10,109	9,242	7,331	9,242	7,331
Subtotal:	$468,366	$458,108	$377,168	$378,257	$343,964	$344,592	$293,048	$296,032	$329,902	$332,886
Design, CM, & Owner Costs	106,489	111,903	81,985	89,961	74,734	82,595	65,620	71,928	75,852	82,160
Contingency Allowance	116,531	115,179	93,354	94,759	84,018	85,341	78,171	79,519	90,611	91,959
Project Reserve (8%)	53,061	52,566	41,951	42,789	37,968	38,753	32,697	33,548	37,459	38,310
Total[2][3]	$744,447	$737,756	$594,458	$605,766	$540,684	$551,281	$469,536	$481,027	$533,824	$545,315
Bus Terminal & Ramps	150,000	150,000	150,000	150,000	150,000	150,000	100,000	100,000	120,000	120,000
GRAND TOTAL	$894,447	$887,756	$744,458	$755,766	$690,684	$701,281	$569,536	$581,027	$653,824	$665,315

[1] In thousands of dollars. [2] Full system electrification would cost about $210,000,000 more [3] The long tunnel option in Mission Bay would cost about $93 million more. [4] The King Street Alignment option would cost about $28-35 million more.

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this site would cost $65 million more for the same alignment configuration. The least expensive design option for the Market/Beale Alternative is the cut-and-cover alignment with a terminal station at Mission Street (approximately $540 million). The three-level underground station at Market Street has the greatest capital cost of all design options (approximately $745 million for the cut-and-cover alignment). The increased cost reflects the longer subway alignment and mitigation measures required to support the Bay Bridge anchor block and building foundations along Beale Street, particularly between Mission and Market Streets.

2.3 OPERATING AND MAINTENANCE COST SUMMARY

Annual operating and maintenance (O&M) costs for the No Build, Market/Beale, and Transbay Terminal Site Alternatives were estimated for diesel, liquefied natural gas (LNG), and electric operation for 60 and 86-weekday train operating scenarios. The results of the O&M cost estimation are presented in Table 3.

Total O&M costs range from a low of $49.4 million for the No Build Alternative (60-train scenario) to a high of $71.4 million for the Market/Beale Alternative, 86-train scenario with electric propulsion. The No Build Alternative is approximately $6.7 million less than the least cost option for the build alternatives. For 60 and 86-weekday train scenarios, LNG would incur the lowest O&M cost, slightly less than the cost for operating diesel locomotives. A 60-train per day electrified CalTrain operation is expected to be about $3 million (5 percent) more expensive to operate than either a "clean" diesel or liquefied natural gas CalTrain operation.

In comparing the build alternatives, the Transbay Terminal Site Alternative has slightly lower O&M costs for each option than the Market/Beale Alternative. This difference represents the slightly shorter distance for the Transbay Terminal Site Alternative.

TABLE 3: SUMMARY OF OPERATING & MAINTENANCE (O&M) COST ESTIMATES

STUDY ALTERNATIVE	PCS O&M COST ESTIMATES	SUBWAY STATION O&M COSTS	TOTAL O&M COSTS	INCREMENTAL COSTS	PCS COST PER TRAIN-HOUR
NO-BUILD ALTERNATIVE					
60 trains	$49,399,549	--	$49,399,549	--	$1,777
86 trains	$61,276,160	--	$61,276,160	--	$1,572
MARKET/BEALE TERMINAL					
1. Diesel Operations					
60 trains	$55,377,968	$1,340,000	$56,717,968	$7,318,419	$1,964
86 trains	$68,539,889	$1,340,000	$69,879,889	$8,603,729	$1,740
2. Electric Operations					
60 trains	$58,481,434	$1,340,000	$59,821,434	$10,421,885	$2,074
86 trains	$70,024,990	$1,340,000	$71,364,990	$10,088,830	$1,778
3. LNG Operations					
60 trains	$54,812,563	$1,340,000	$56,152,563	$6,753,014	$1,944
86 trains	$67,491,251	$1,340,000	$68,831,251	$7,555,091	$1,713
TRANSBAY TERMINAL					
1. Diesel Operations					
60 trains	$55,351,964	$1,340,000	$56,691,964	$7,292,415	$1,963
86 trains	$68,528,999	$1,340,000	$69,868,999	$8,592,839	$1,740
2. Electric Operations					
60 trains	$58,451,590	$1,340,000	$59,791,590	$10,392,041	$2,073
86 trains	$69,987,817	$1,340,000	$71,327,817	$10,051,657	$1,777
3. LNG Operations					
60 trains	$54,791,334	$1,340,000	$56,131,334	$6,731,785	$1,943
86 trains	$67,464,999	$1,340,000	$68,804,999	$7,528,839	$1,713

NOTES:

(1) Costs based on operating statistics defined by David Minister, Aug-30-95.
(2) Cost estimated for each alternative in 1995 dollars.
(3) Costs for each alternative based on 60 and 86 trains scenarios.
(4) Incremental costs relative to No-Build alternative.
(5) Cost Summary tables for each alternative provided in the Appendix.
(6) Cost of operating ventilation fans not included. Add approximately $100,000 annually to diesel and LNG costs.
(7) Factors considered in determining O&M costs are as follows: 1) Annual passengers; 2) Number of peak-period gallery cars; 3) Total gallery car fleet size; 4) Peak-period locomotive requirements; 5) Total locomotive fleet size; 6) Annual train trips; 7) Total annual train trips; 8) Total annual train miles; 9) Total annual car-miles; 10) System route-miles; 11) Total number of stations; 12) Terminal stations; 13) Storage and maintenance yards; 14) Park-and-ride spaces; and 15) Fuel costs.

Prepared by: Manuel Padron & Associates, 09/19/95

2.4 KEY DECISIONS

DECISION #1: Which East/West Alignment and Short or Long Tunnel Option Should Be Selected? (Figure 3).

TABLE 4: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #1

Major Construction Impacts			
Townsend at Fifth (Short Tunnel)	***King at Sixth (Short Tunnel)***	***Townsend at Seventh & Berry (Long Tunnel)***	***King at Seventh & Berry (Long Tunnel)***
• Least capital cost ($152 million)	• Capital cost $180 million, about $28 million more than Fifth/Townsend because of longer subway	• Capital cost $245 million, about $93 million higher than Fifth/Townsend because of 2,500' longer subway	• Capital cost $230 million, $15 million less than Townsend at Seventh/ Berry Streets because of less utility and street relocation on King
• Disruption to many businesses on north side of Townsend Street, including access impacts and construction noise • More historic properties affected along Townsend Street	• Greater traffic disruption due to future traffic volumes on King Street at I-280 ramps • Newly-constructed King Street (southbound lanes) would be torn up • Trunk sewer line under King adjacent to construction zone	• Requires relocation of four major sewer box structures (Division Street Outfall)	• Requires relocation of four major sewer box structures (Division Street Outfall) • Greater traffic disruption due to future traffic volumes on King Street at I-280 ramps • Newly-constructed King Street (southbound lanes) would be torn up • Trunk sewer line under King adjacent to construction zone
Long Term Benefits/Impacts			
Townsend at Fifth	***King at Sixth***	***Townsend at Berry***	***King at Berry***
• Requires up to 55 feet of Catellus property for surface and portal construction • Does not conform with Mission Bay Plan • Frees most of existing CalTrain station and yard area for development • Blocks access along Fifth into Mission Bay • Involves grade crossings of the eastbound lanes of Townsend, Sixth and King Streets	• Requires some Catellus property but less than at Fifth & Townsend • Does not conform with Mission Bay Plan • Frees most of existing CalTrain station and yard area for development	• Does not require Catellus property • Conforms with Mission Bay Plan • More difficult to access CalTrain storage yard at 16th/ I-280 • Allows higher speed curve for trains, slight decrease in running times • Frees entire CalTrain station and yard area (30 acres) for development • Permits greater flexibility in the location of a possible future Mission Bay station	• Does not require Catellus property • Conforms with Mission Bay Plan • More difficult to access CalTrain storage yard at 16th/ I-280 • Allows higher speed curve for trains, slight decrease in running times • Frees entire CalTrain station and yard area (30 acres) for development • Permits greater flexibility in the location of a possible future Mission Bay station

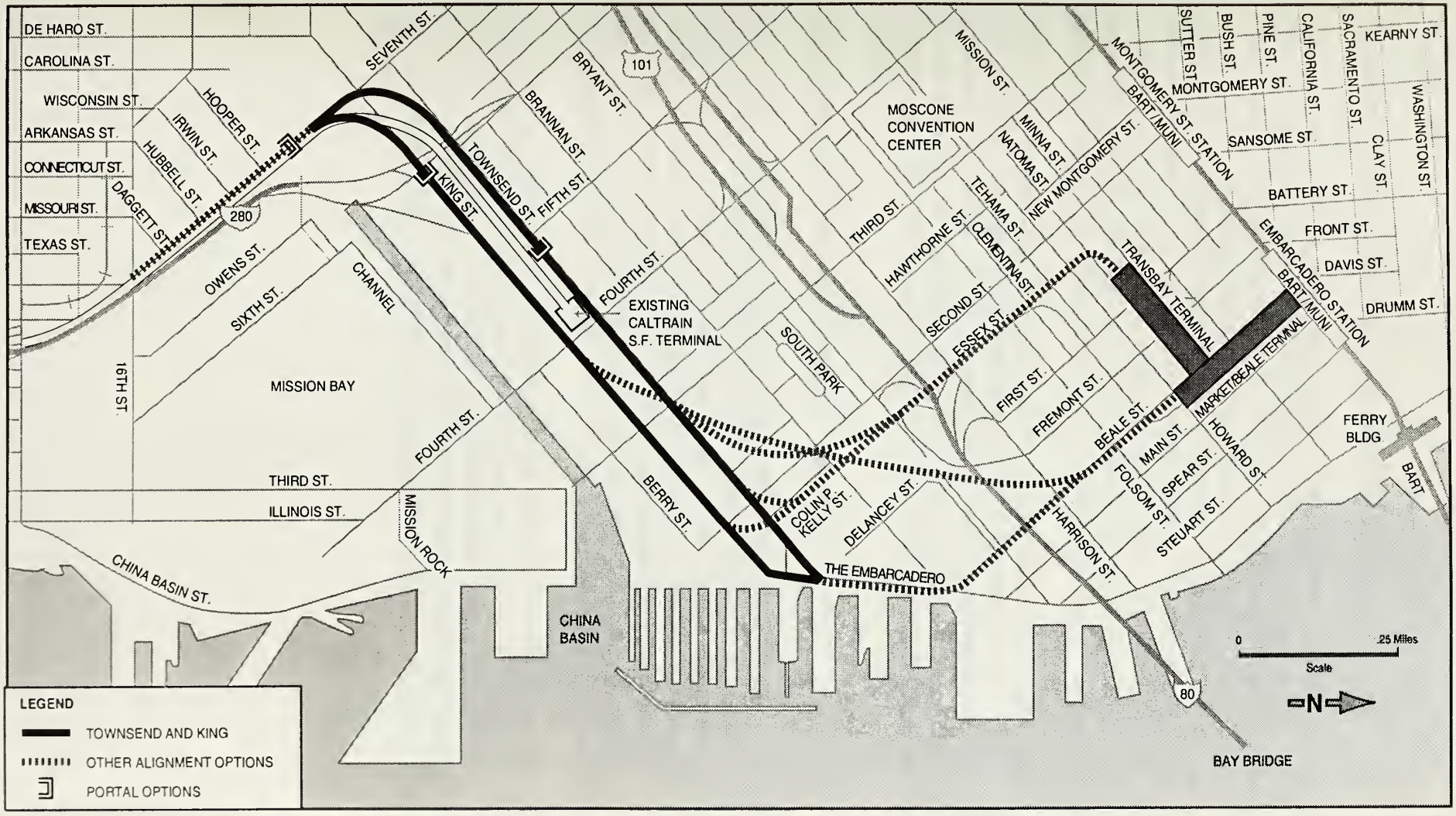

FIGURE 3
TOWNSEND AND KING STREETS: ALIGNMENT OPTIONS

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Townsend Street with Portal near Fifth/Townsend - Figure 4

The Townsend Street alignment with a portal location east of Fifth/Townsend would offer the lowest capital cost ($152 million) of all the design options. The lower capital cost is due to this option having the shortest length of underground construction. The alignment would require up to 55 feet of Catellus property to widen the Townsend Street right-of-way between Seventh and Third Streets and to construct the cut-and-cover subway (Figure 5). Subway construction activities would create short term noise, vibration, and access impacts to businesses on the north side of Townsend. Relocation of sewer, PG&E, Pacific Bell, and Sprint lines would also result from construction. More historic structures would be affected by construction along Townsend than along King.

The portal location near Fifth/Townsend would permanently block access to Mission Bay from Fifth Street and would sever a portion of Catellus property (which will eventually be transferred to the City under the Mission Bay Development Agreement) at Seventh/ Townsend from the remainder of Mission Bay property. The portal location would also require CalTrain grade crossings of the eastbound lanes of Townsend, Sixth and King Streets.

King Street with Portal near Sixth/King - Figure 4

The capital cost of the King Street alignment with a portal east of Sixth/King would be $180 million, $28 million higher than the Townsend Street alignment with a portal at Fifth/Townsend. The increased cost is due to the slightly longer subway alignment. Catellus property would be required for portal and subway construction between Seventh and Fifth Streets, although not as much land as for the Townsend Street alignment. Since much of the land along King Street is now vacant, disruption to businesses because of construction activities would not be as extensive as along Townsend Street.

Disruption of traffic flow along King Street, however, would be severe. After completion of the King Street roadway and Muni Metro extension in 1996, King will become the primary thoroughfare connecting The Embarcadero with I-280. Cut-and-cover construction in the southbound lanes and adjacent sidewalk along King Street would require tearing up this newly-constructed street, rerouting traffic, and resurfacing the street (Figure 6).

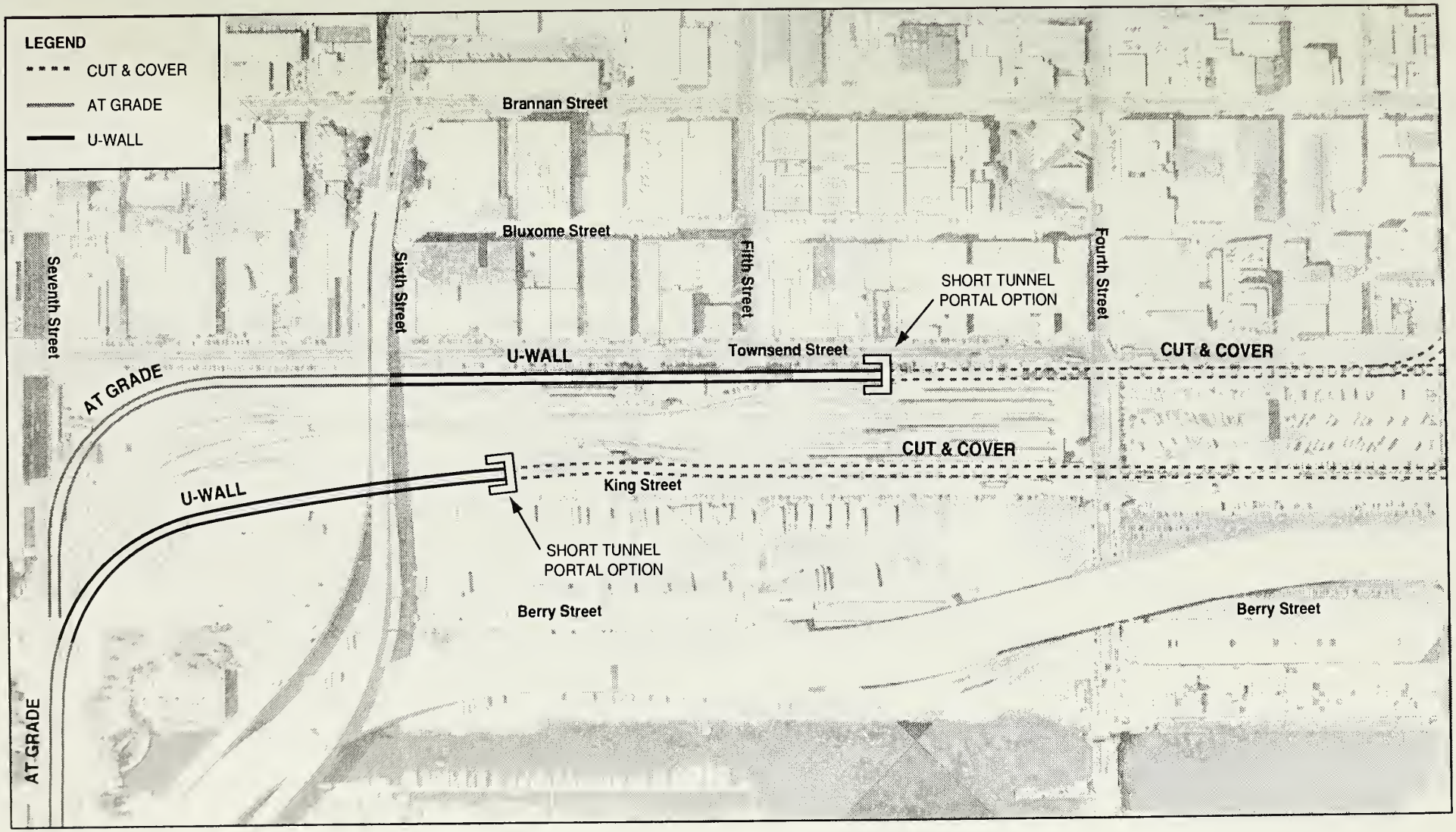

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FIGURE 4

MARKET/BEALE ALTERNATIVE: TOWNSEND AND KING STREETS SHORT TUNNEL PORTAL OPTIONS

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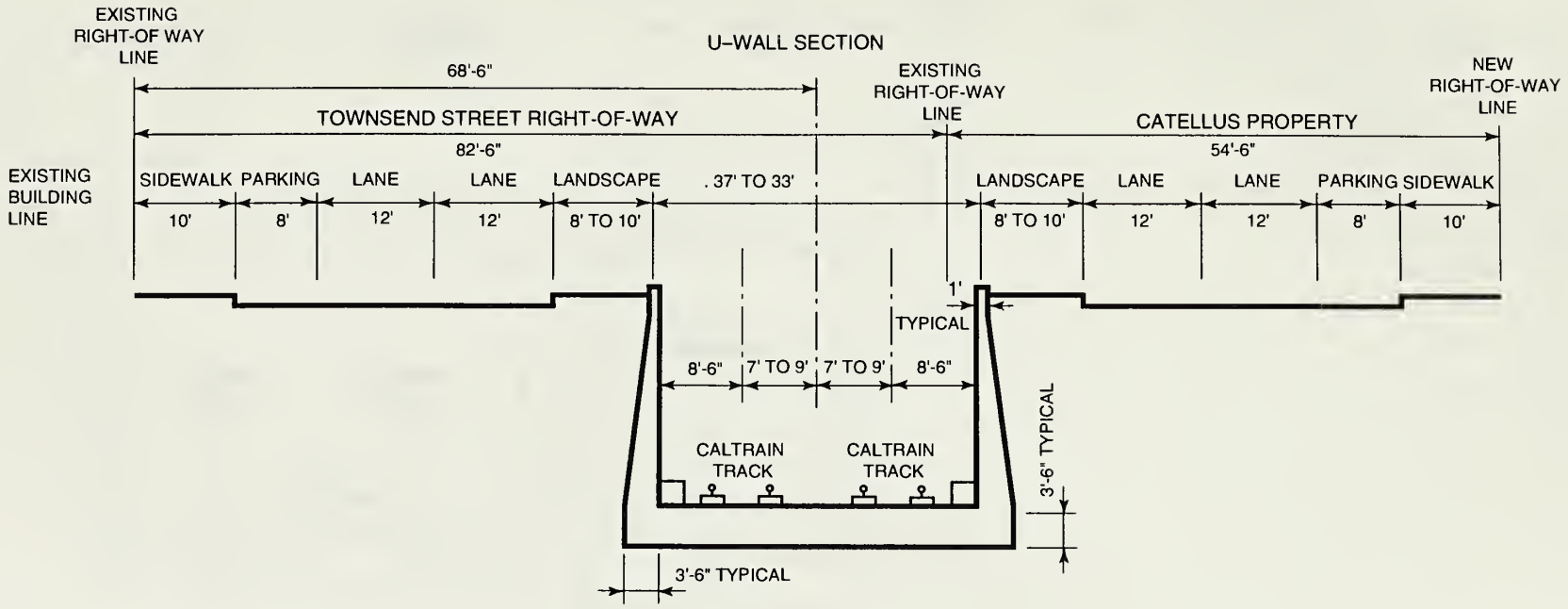

TYPICAL SECTION
RETAINED CUT TRANSITION

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FIGURE 5
TOWNSEND STREET CROSS SECTION AT FIFTH STREET (LOOKING EAST)

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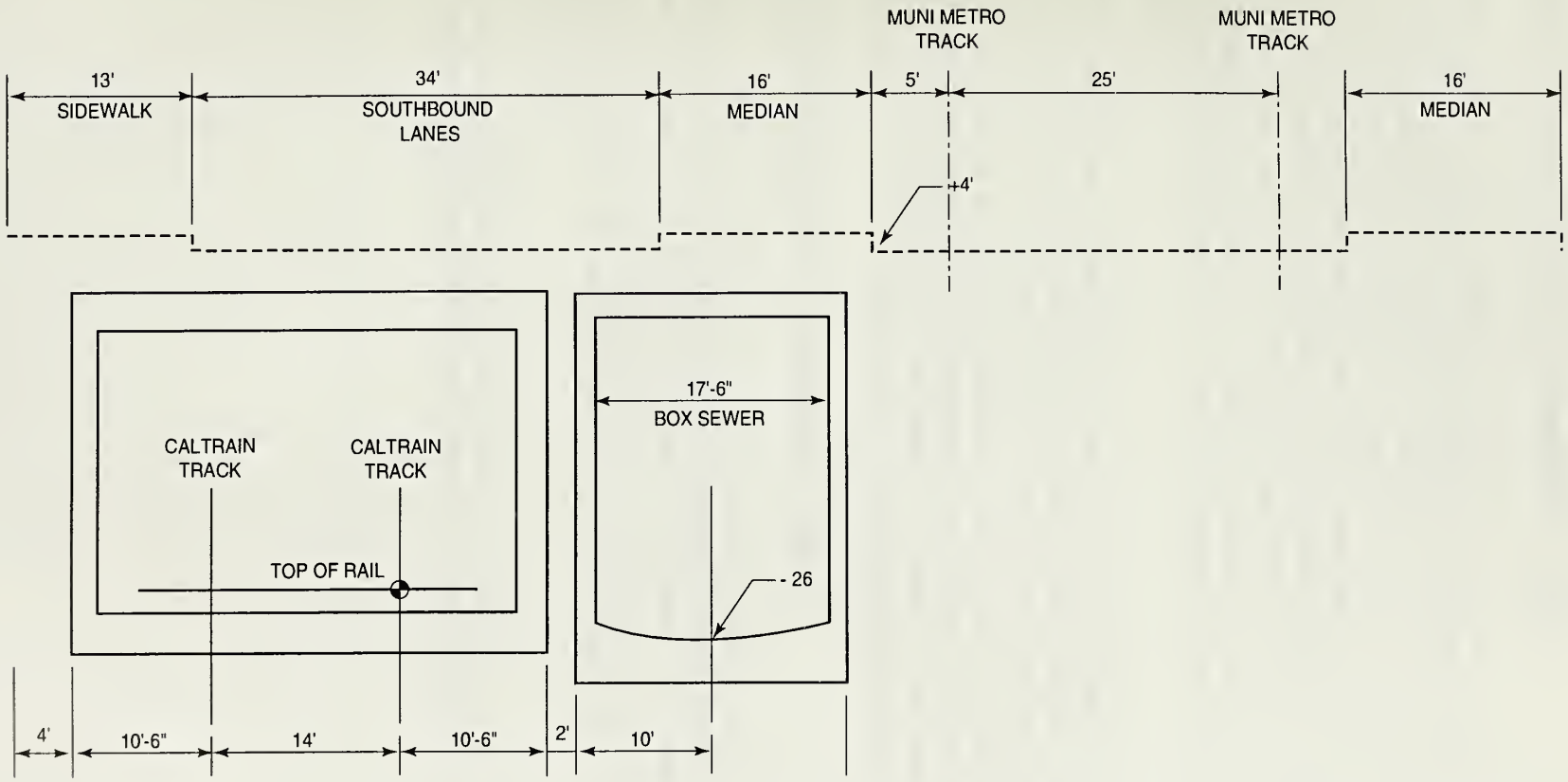

FIGURE 6
KING STREET CROSS SECTION AT FOURTH STREET (LOOKING EAST)

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Townsend Street with Portal near Seventh/Berry - Figure 7

A longer subway along Townsend starting from a portal south of Berry Street near Seventh Street would be the most expensive design option ($245 million), approximately $93 million higher than the short portal location at Fifth/Townsend and $15 million higher than the long portal option along King Street. Although the capital cost is significantly higher, the long portal option would not block access to Mission Bay and would allow complete development of the existing CalTrain station and track storage area (30 acres). As a result, the long portal location more readily conforms with the 1990 Mission Bay Plan than the other portal options. However, this portal location would require relocation of four major box sewers known as the Division Street Outfall Structure.

From an operational standpoint, the portal at Seventh/Berry would permit a longer radius curve as it turns toward the east from Seventh Street. The longer radius curve would allow trains to operate at up to 40 miles per hour along the curve, twice the speed of trains operating along the alignment for either short portal tunnel option. The faster speed would decrease CalTrain running times slightly. For storage of trains at the proposed yard in Mission Bay, the portal's proximity to the potential train storage yard would place a portion of the yard lead track within the below-ground U-wall section.

King Street with Portal near Seventh/Berry - Figure 7

A longer subway along King with a portal south of Berry at Seventh Street would be slightly less than the long tunnel along Townsend Street because construction would involve less street and utility relocations. The capital cost would be $230 million, $50 million more than the short tunnel option at King near Sixth. All of the advantages and disadvantages of the Townsend Street long tunnel alignment would apply to this design option as well.

This option would cause severe disruption of traffic flow on King Street during construction, similar to the King Street with portal near Sixth/King option.

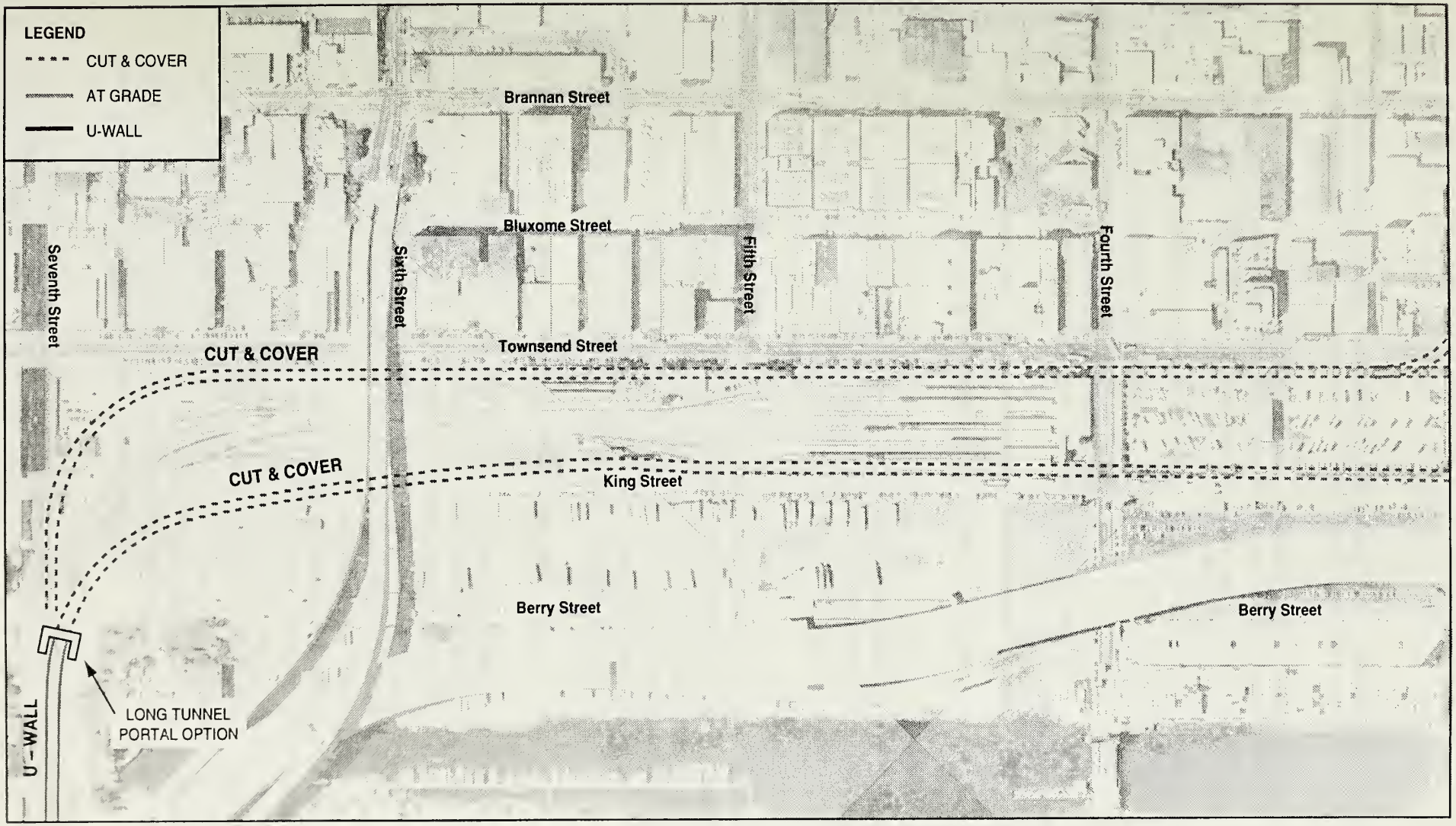

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FIGURE 7
MARKET/BEALE ALTERNATIVE:
TOWNSEND AND KING STREETS
LONG TUNNEL PORTAL OPTIONS

◆ ICF KAISER/DELEUW

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DECISION #2: Which North/South Alignment and Underground Construction Technique Should Be Selected for the Market/Beale Alternative? (Figure 8)

TABLE 5: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #2

Major Construction Impacts	
Cut-and-Cover	***Mined Tunnel***
• Capital cost about the same as for the mined tunnel option • Disruption to businesses and residences in South Beach - noise, vibration, traffic, access, air quality • Would require protection of Bay Bridge anchor block • Less risk to integrity of existing structures during construction	• Avoids disruption to businesses and residences in South Beach neighborhood • Risk of cave-ins because of extremely poor rock conditions in Rincon Hill • Requires access shaft on Catellus property at Third/ Townsend • Must pass under historic buildings on north side of Townsend east of Third Street

Cut-and-Cover Alignment to Market/Beale Terminal - Figure 9

Cut-and-cover construction would cost about the same as a mined tunnel under Rincon Hill. The alignment would pass by the South Beach Marina Apartments, the Delancey Street Project, Bayside Village Apartments, and Baycrest Condominiums producing short term noise, dust, and vibration impacts during construction. Access to businesses also would be temporarily affected.

Cut-and-cover construction would require excavation of the southbound lanes of The Embarcadero roadway, which was recently landscaped and reconstructed. Excavation would disrupt traffic flow along The Embarcadero to King Street and I-280 (Figure 10). Muni Metro service and access to Muni Metro stations would be maintained during construction. In addition, the cut-and-cover construction would require protection of the nearby Bay Bridge anchor block from any settling/shifting.

Mined Tunnel Alignment to Market/Beale Terminal - Figure 9

Rincon Hill consists mostly of fractured rock with groundwater above the tunnel profile. Therefore mining a tunnel carries the risk of cave-ins and greater risk of affecting the structural integrity of streets, utilities, and buildings, including historic structures, situated above the tunnel. Because these rock and groundwater conditions represent a poor medium for tunneling, a panel of geotechnical engineers and tunneling experts assembled for this study has recommended a highly cautious tunneling technique, if tunneling were pursued. Even with this approach, a high potential for cave-ins would remain. An access shaft needed to construct the mined tunnel would occur on Catellus property near Third and Townsend, requiring temporary acquisition of a construction staging site at this location. The mined tunnel offers the advantage of producing far less surface disruption during construction (traffic, air quality, noise, pedestrian access) than the cut-and-cover option. This difference may be important to residences and businesses adjacent to the alignment, particularly in the South Beach area, where reconstruction of The Embarcadero roadway was recently completed.

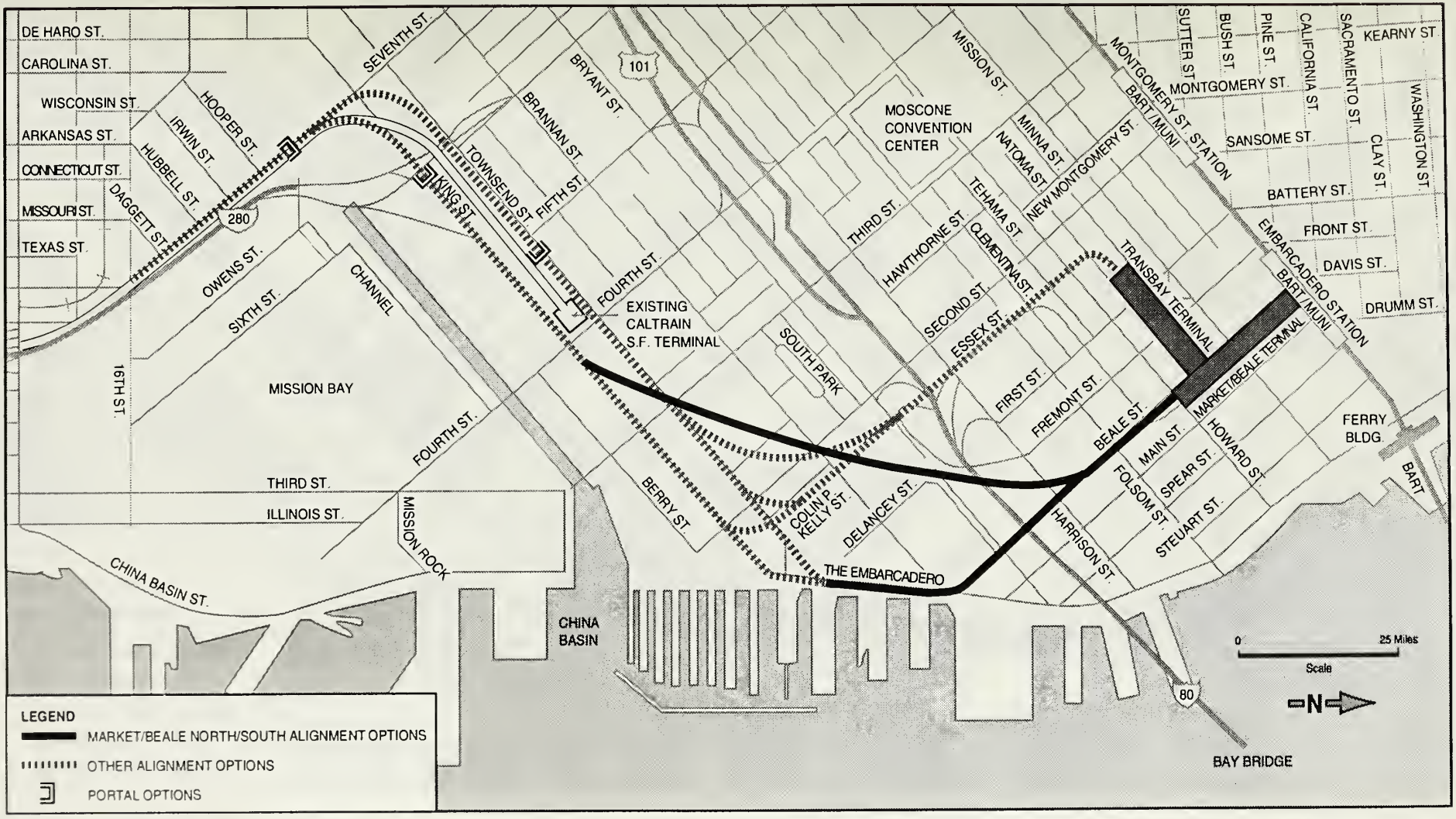

FIGURE 8
MARKET/BEALE NORTH/SOUTH ALIGNMENT OPTIONS

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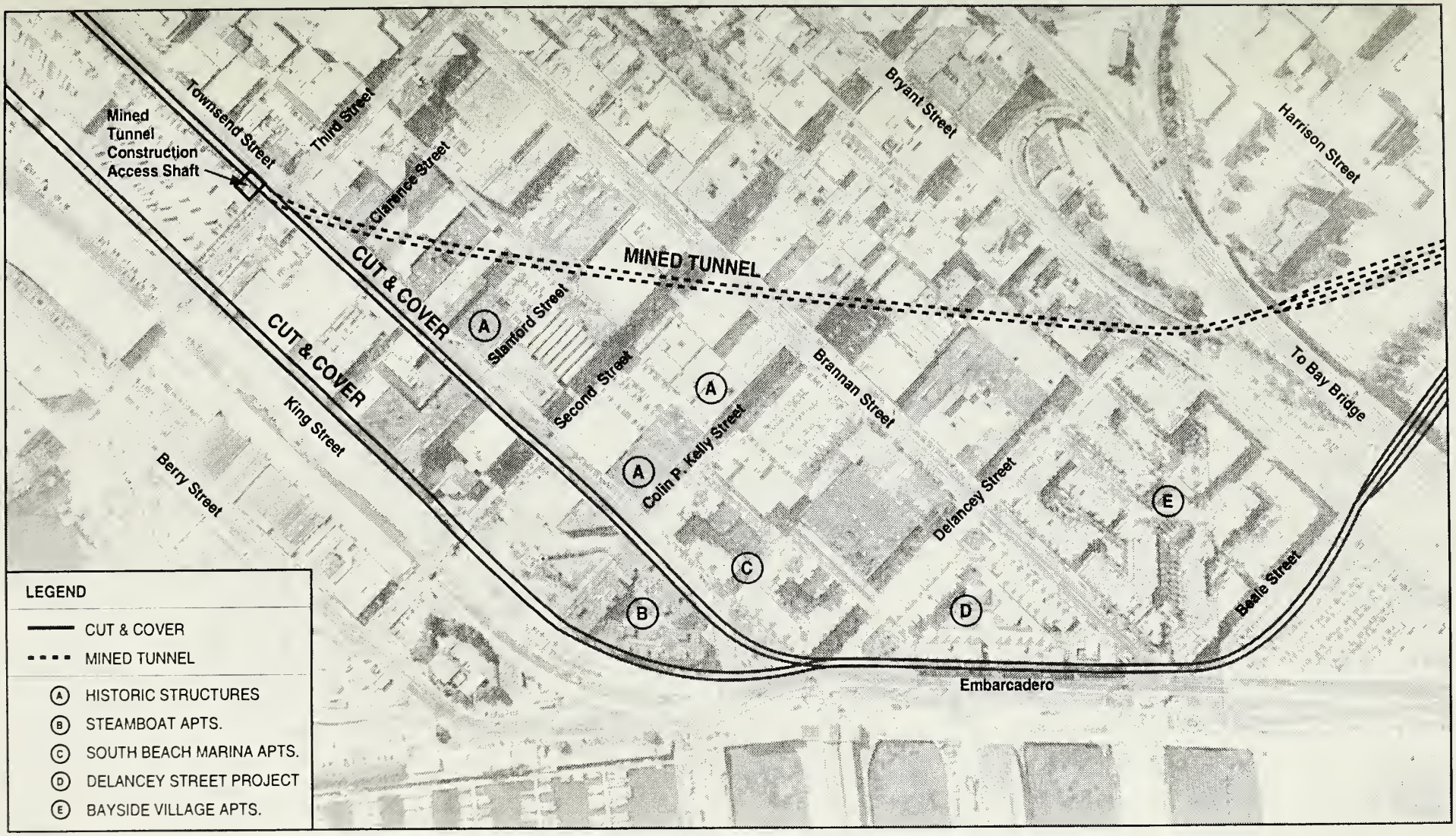

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FIGURE 9

MARKET/BEALE ALTERNATIVE: CUT & COVER AND MINED TUNNEL ALIGNMENT OPTIONS

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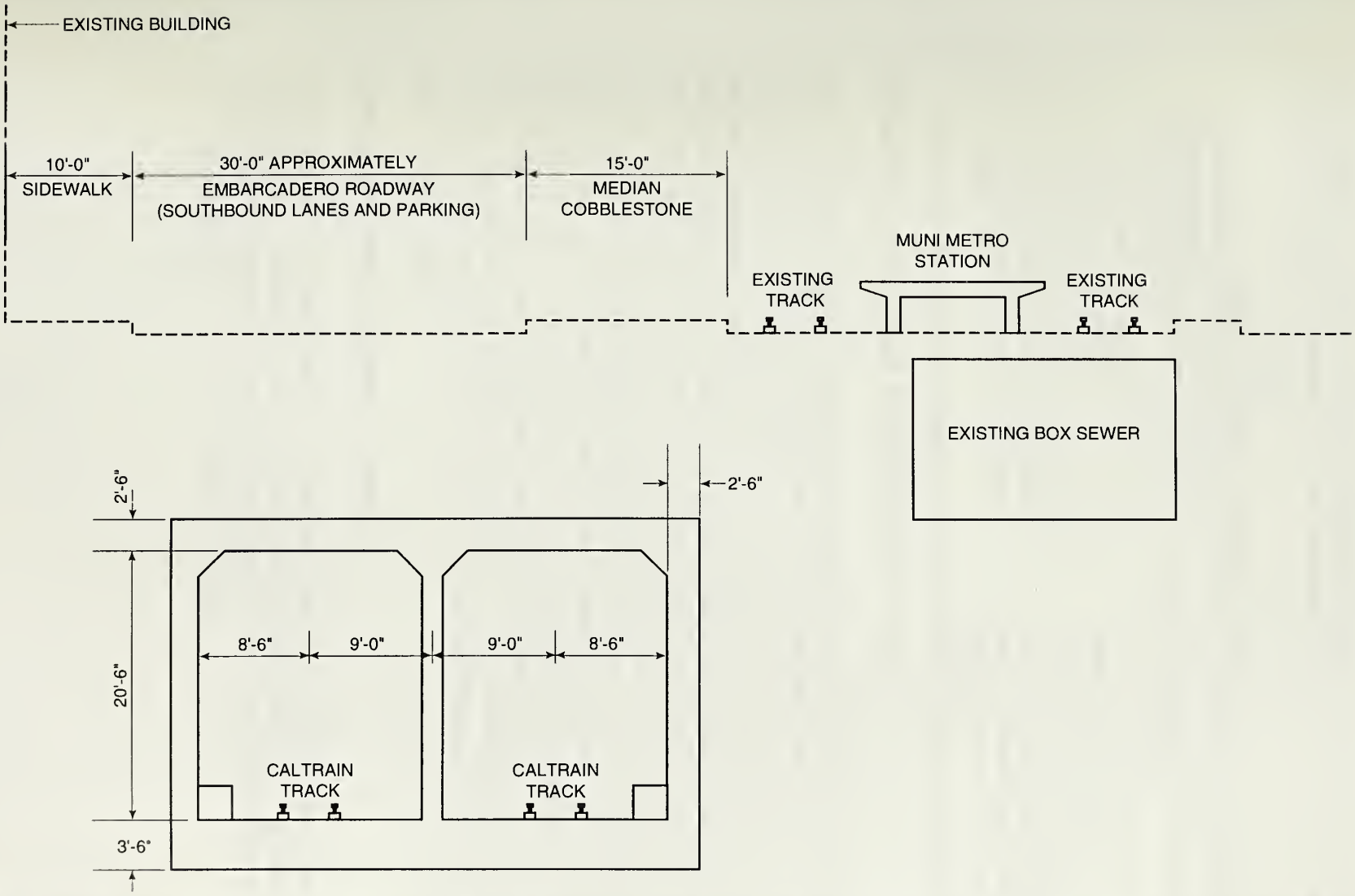

FIGURE 10

MARKET / BEALE ALTERNATIVE:
THE EMBARCADERO CROSS SECTION
(LOOKING NORTHEAST)

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DECISION #3: Which North/South Alignment and Underground Construction Technique Should Be Selected for the Transbay Terminal Site Alternative? (Figure 11)

TABLE 6: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #3

Major Impacts	
Short Mined Tunnel	***Long Mined Tunnel***
• Capital costs are about the same as for the long mined tunnel option • Disruption to South Beach Marina Apartments • Passes under two historic buildings on north side of Townsend east of Second Street • Would Disrupt Business at South Beach Billiards	• Longer tunnel under more buildings creates a greater risk of cave-ins • Requires temporary construction access shaft on Catellus property at Third/Townsend • Must pass under historic buildings on north side of Townsend east of Third Street • Less disruption to South Beach Marina Apartments

Cut-and-Cover/Short Mined Tunnel Alignment - Figure 12

The cut-and-cover/short mined tunnel alignment would cost about the same to construct as a long mined tunnel. The alignment would pass under two or three historic warehouses on the north side of Townsend west of Colin P. Kelly Street. Various building support techniques would need to be employed to preserve these historic structures. Because of the narrow 55-foot wide right-of-way along Colin P. Kelly Street, cut-and-cover construction would encroach on the surface parking lot along the east side of the street. Short term construction impacts would occur in the area adjacent to the western edge of the South Beach Marina Apartment complex. North of Brannan, the access shaft for the short mined tunnel would be located in the parking lot fronting South Beach Billiards. Construction of the short mined tunnel would disrupt business activity at South Beach Billiards. The short mined tunnel for this option would travel for half the distance of the long mined tunnel option and would be deep within Rincon Hill (see Figure 13). Therefore, the study's tunneling experts believe that this tunnel is less risky than the other tunnel options.

Long Mined Tunnel Alignment - Figure 12

The long mined tunnel would produce less disruption to businesses and residences in South Beach. However, the risk of cave-ins during excavation is greater for the long mined tunnel option. An access shaft needed to construct the mined tunnel would occur on Catellus property near Third and Townsend.

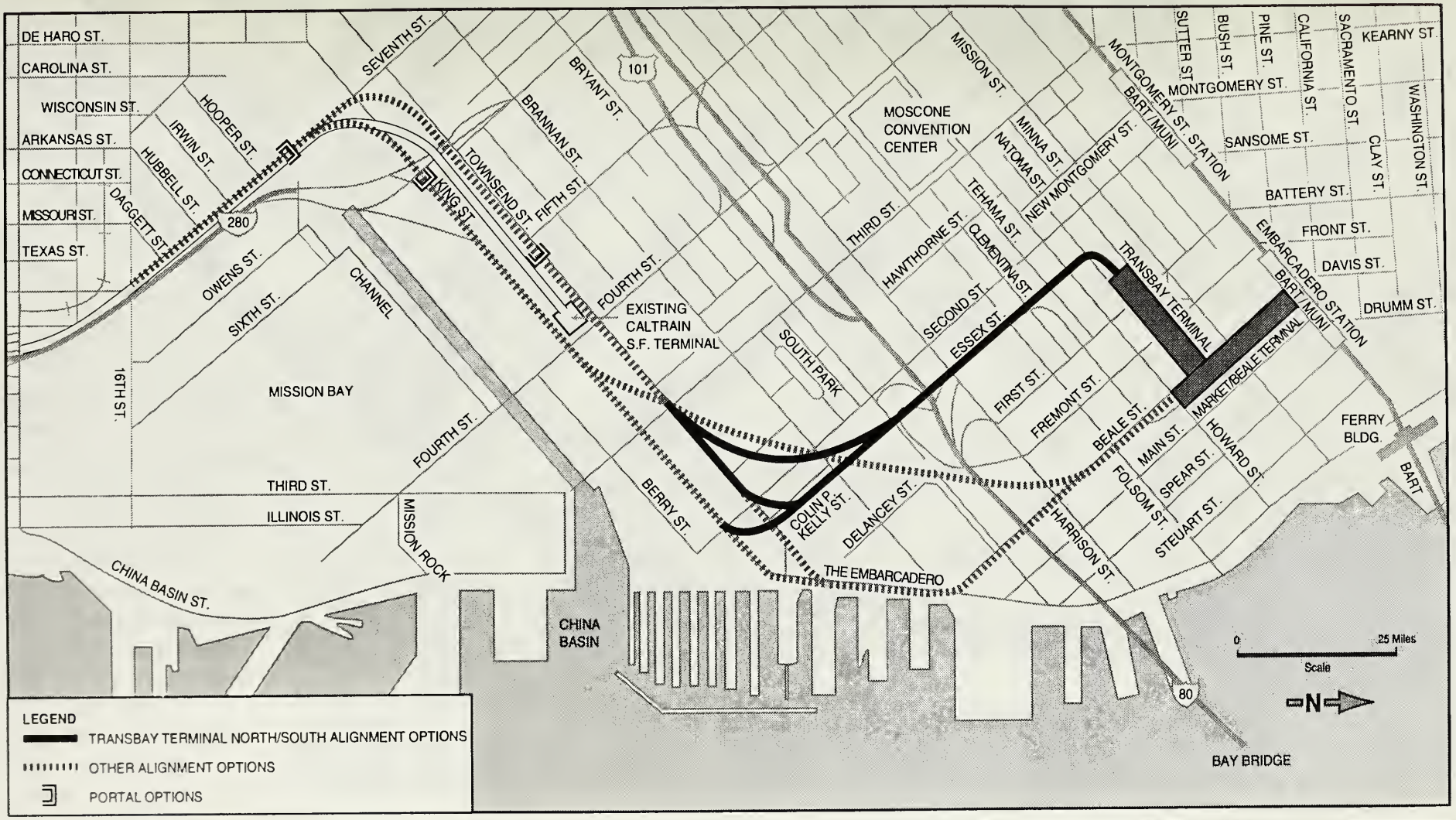

FIGURE 11
TRANSBAY TERMINAL NORTH/SOUTH ALIGNMENT OPTIONS

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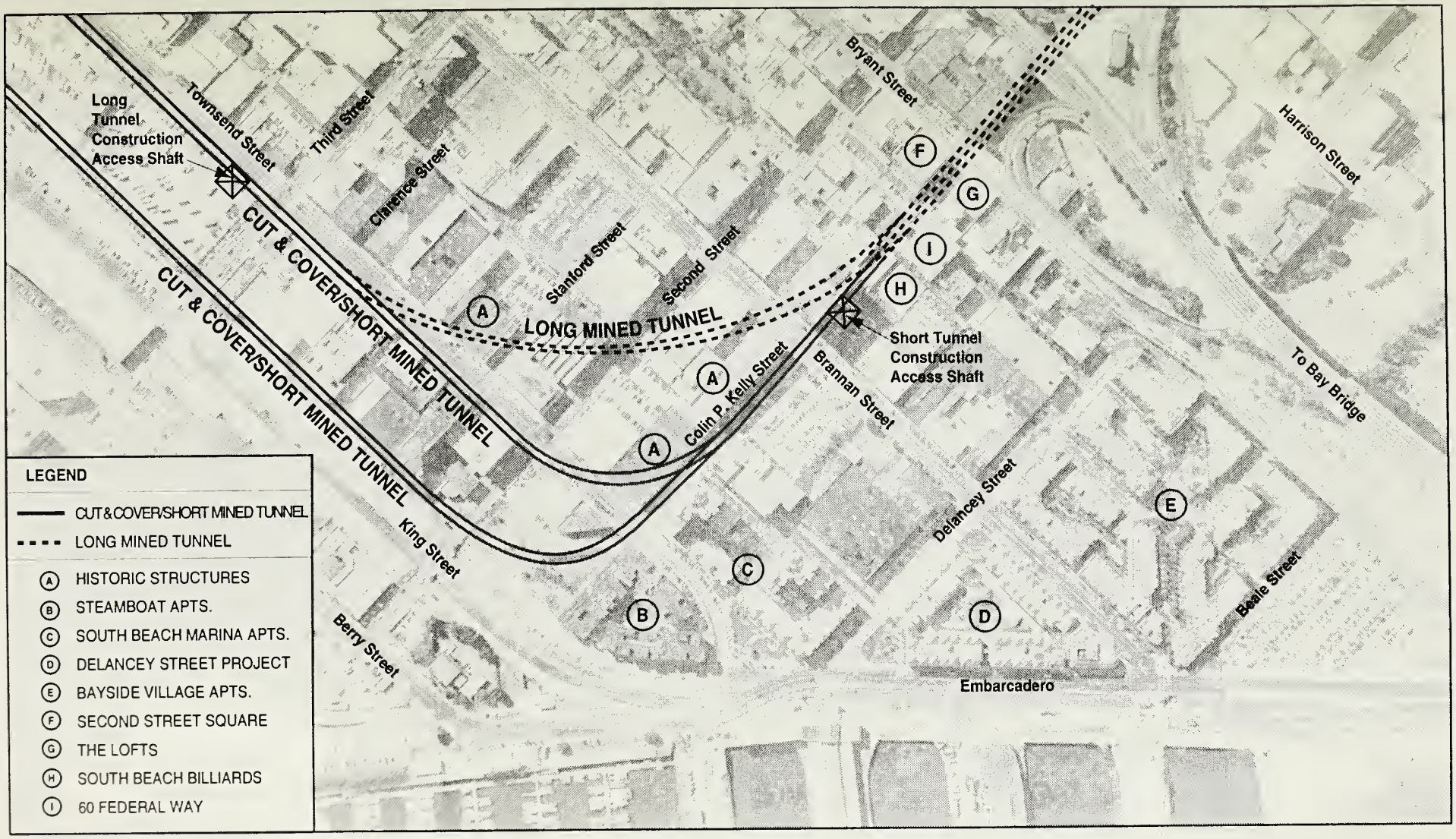

FIGURE 12

TRANSBAY TERMINAL SITE ALTERNATIVE: SHORT AND LONG MINED TUNNEL ALIGNMENT OPTIONS

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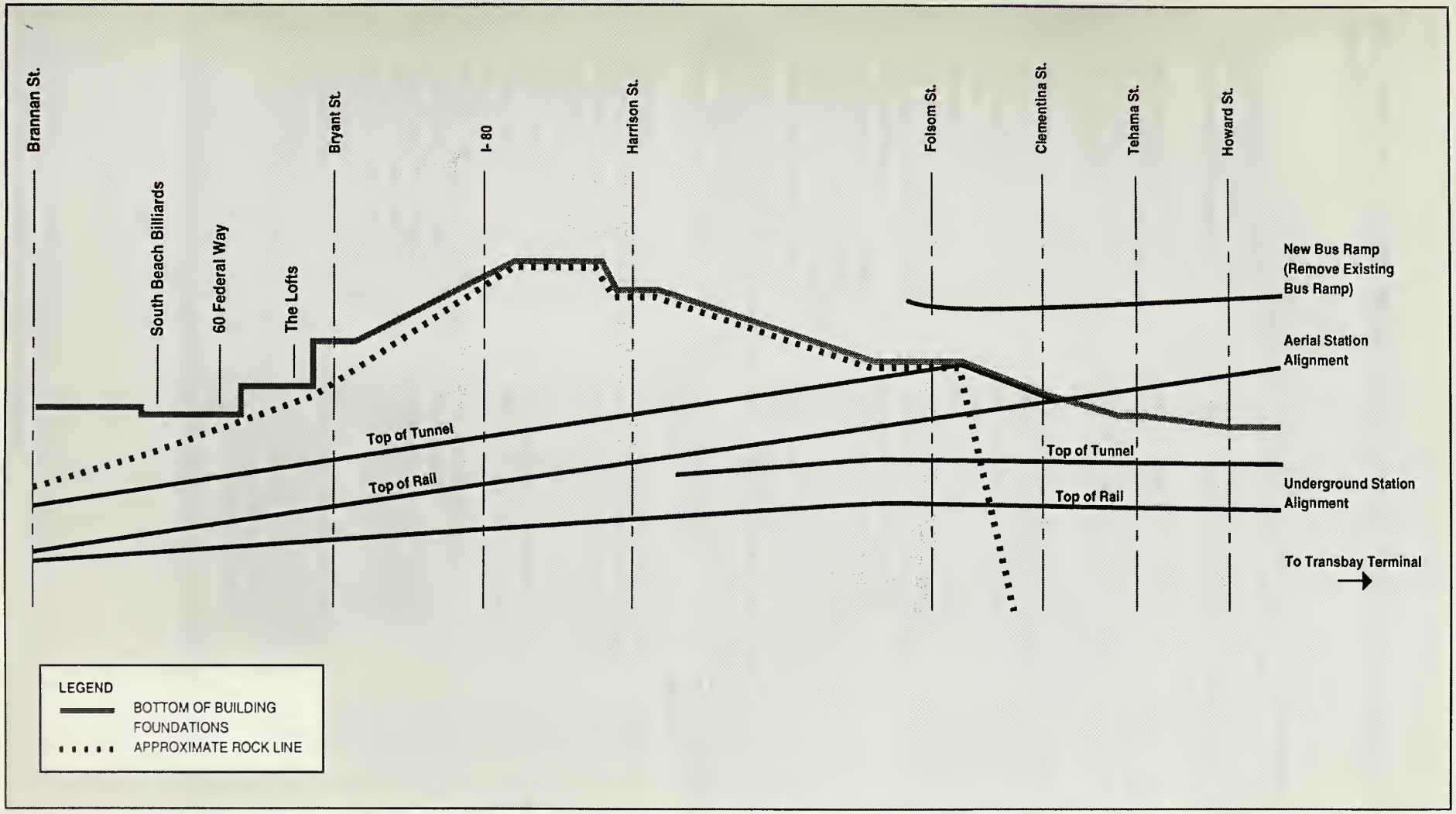

FIGURE 13

TRANSBAY TERMINAL SITE ALTERNATIVE: RINCON HILL TUNNEL PROFILE SCHEMATIC

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DECISION #4: Which Market/Beale Terminal Configuration Option Should Be Selected?

TABLE 7: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #4

Major Construction Impacts		
Three-level Underground	***Two-level Underground (staggered)***	***Two-level Underground at Mission***
• Highest capital cost - $745 million. (Townsend/Fifth Street portal, "clean" diesel propulsion)	• Medium capital cost - $150 million less than three-level terminal option	• Lowest capital cost - $200 million less than three-level terminal option
• High disruption of traffic and pedestrian circulation, especially between Market Street and Mission Street • Greatest risk to adjacent buildings because of depth of cut-and-cover excavation and poor soil conditions • Two large underground structures associated with adjacent high rises along Beale between Market and Mission Streets would have to be removed.	• High disruption of traffic and pedestrian circulation, especially between Market Street and Mission Street • Two large underground structures associated with adjacent high rises along Beale between Market and Mission Streets would have to be removed. • Would require coordination with City of SF should City decide to build new Transbay Terminal on Main/Beale site.	• Least disruption of traffic and pedestrian circulation • Would require coordination with City of SF should City decide to build new Transbay Terminal on Main/Beale site
Long Term Benefits/Impacts		
Three-level Underground	***Two-level Underground (staggered)***	***Two-level Underground at Mission***
• Superior connectivity; direct connection to BART/Muni Metro (4 tracks) at Market Street • Requires no private property other than Beale St. underground structures • Least suitable for joint development • Provides the opportunity for the longest length for future Intercity/High Speed Rail platforms • Presents greatest difficulty for fire fighters to locate and access tunnel fires due to three-level structure design	• Direct connection to BART/Muni Metro (2 tracks) at Market Street; underground concourse with 650 ft. moving sidewalks to Market Street • Requires portion of Pacific Gateway Building and Caltrans property • More suitable for joint development • Constrains opportunity for the length of future Intercity/High Speed Rail platforms (700 ft. max) • Offers slight advantage in terms of travel time to nearby commuter destinations because of number of station access points extending between Market and Folsom	• Least favorable connection to BART/Muni Metro; no tracks at Market Street; underground concourse with 650 ft. moving sidewalks to Market Street • Requires portion of Pacific Gateway Building and Caltrans property • More suitable for joint development • Constrains opportunity for the length of future Intercity/High Speed Rail platforms (700 ft. max)

Three-Level Underground Terminal at Market Street - Figures 14 and 15

The capital cost for a three-level underground station at Market Street would cost about $200 million more than for a two-level configuration with all tracks terminating at Mission Street. The additional cost is attributed to the added alignment length (650 feet more for tracks to reach Market Street); the long underground structure needed to transition the tracks into a double stacked configuration; the depth of construction; the proximity of construction to the foundations of several high rise buildings; and the removal of two large underground structures associated with two adjacent buildings which extend into the Beale Street right-of-way. This design option would affect the most buildings and restrict pedestrian and traffic circulation along Beale during construction.

The 82.5-foot Beale Street right-of-way and building foundations bordering the street would constrict the station width to 70 feet. The 82.5 foot width of Beale Street would be sufficient to place support structures (soldier piles and slurry walls) within three feet of the building foundations and to construct the station.

The narrow right-of-way requires two platform levels for this station, each containing two tracks. To accommodate this configuration, the north/south alignment would have to expand to four tracks just north of the Bay Bridge. At this point, the two inside tracks would dive down while the two outside tracks would angle up and together so that the four tracks would then transition into a double-stacked alignment as it would traverse Beale Street north into the three-level underground terminal. The three-level underground terminal structure and double-stacked tunnel would present the greatest difficulty for fire fighters to locate and access fires or other emergency situations occurring in the tunnel or station area.

This design option would offer the best connection to BART and Muni Metro at the Embarcadero Station, since all four tracks would terminate just south of Market Street. The CalTrain and Embarcadero Station mezzanines would be directly connected, permitting quick and convenient transfers to BART and Muni Metro. Because of the station's three-level depth below sidewalks and because destinations of CalTrain commuters are dispersed north and south of Market Street, no clear overall travel time advantage over the other terminal design options would result from this option.

The three-level underground station would not require private property for station construction, other than for the two aforementioned underground structures in Beale Street north of Mission Street. By not using the Pacific Gateway and Caltrans property south of Mission for CalTrain, impacts to the Pacific Gateway Building could be avoided and more area would be available for a possible future Intercity/High Speed Rail terminal. In addition, the location of the three-level terminal to the north of Folsom would minimize the length of lead track required to access a possible future Intercity/High Speed Rail station area, ensuring 1000-foot platform lengths.

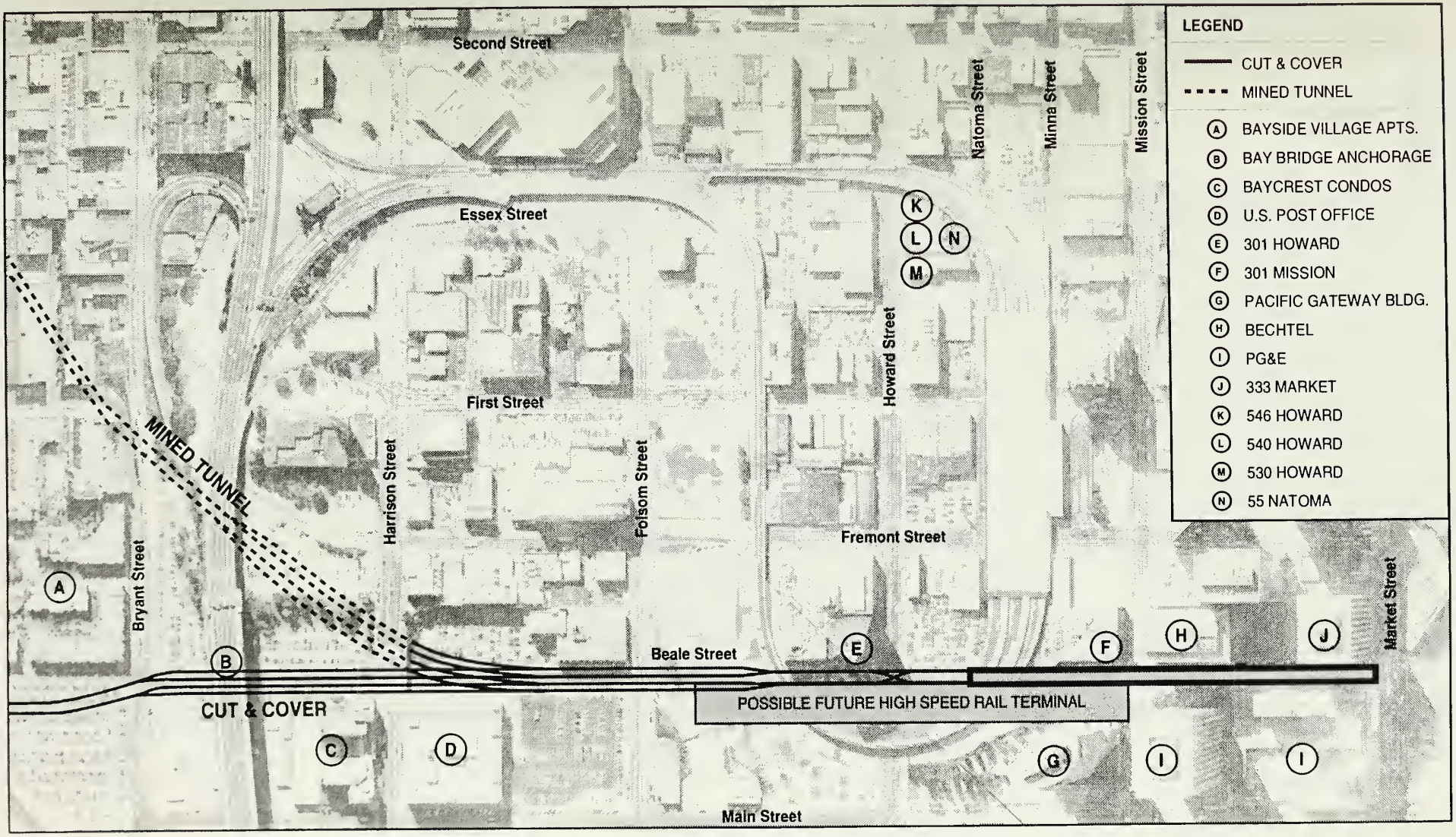

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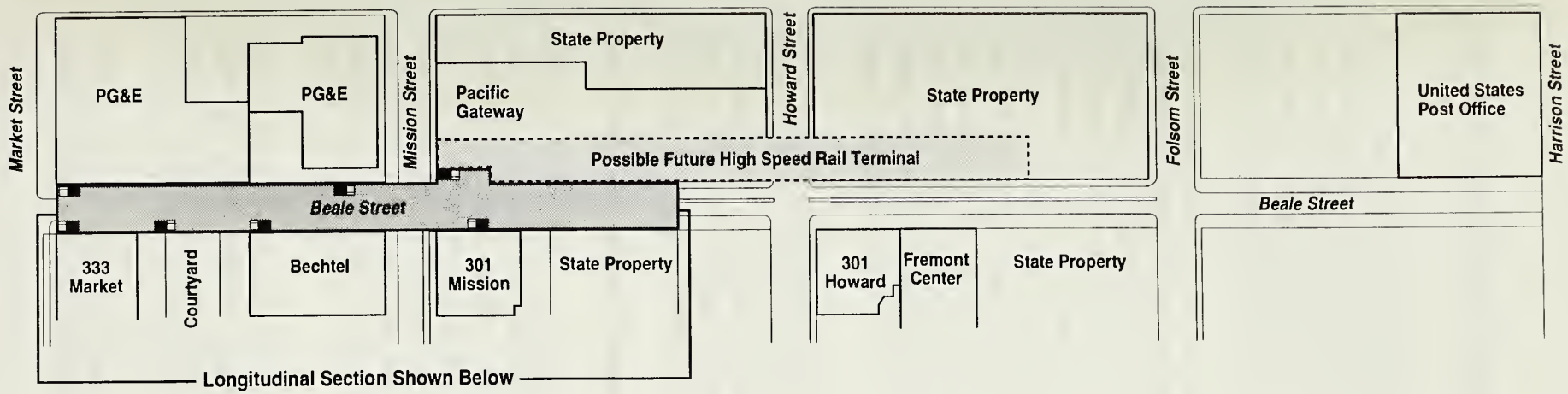
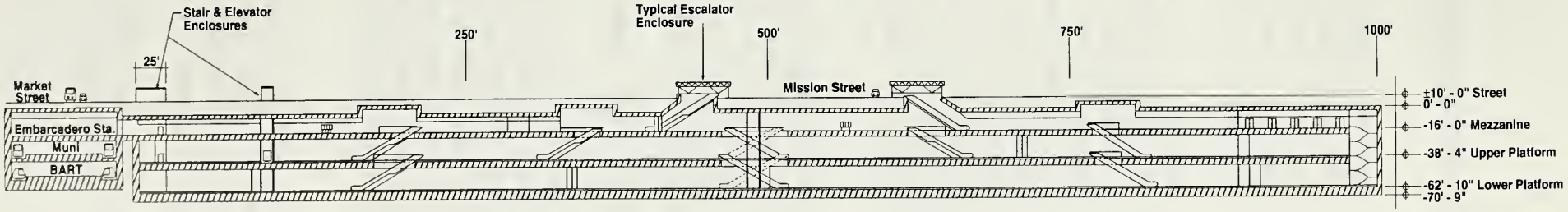
FIGURE 14

MARKET/BEALE ALTERNATIVE:
TERMINAL CONFIGURATION OPTIONS
THREE-LEVEL UNDERGROUND AT MARKET STREET

◆ ICF KAISER/DELEUW

J95-068 fig 14 Mc4





Schematic Not to Scale

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FIGURE 15

MARKET/BEALE ALTERNATIVE:
TERMINAL AREA AND LONGITUDINAL SECTION
THREE-LEVEL UNDERGROUND AT MARKET STREET

◆ ICF KAISER/DELEUW

J95-068 FIG 15 Mc4

Two-Level Underground Terminal (Staggered) Between Market and Mission Streets - Figures 16 and 17

Capital cost for the Market/Beale terminal configuration with two tracks terminating at Market Street and two tracks terminating at Mission Street would be about $150 million less than for the three-level underground station. This station configuration would be on two levels and have entry points between Market and Folsom Streets (with moving sidewalks on the mezzanine level between Mission and Market Streets).

The station area for the two-level station configuration would use Caltrans and Pacific Gateway property (south of Mission), requiring the demolition of the two-story Pacific Gateway atrium structure on the west side of the building. Construction of the station at this location would encounter the greatest extent of hazardous material (coal tar) deposited from a 19th century coal gasification plant located near Howard and Beale Streets. Construction would also disrupt traffic and pedestrian circulation as in the three-level station design option. Following station construction, the area between Main and Beale above the two-level station would be available for joint development, an advantage over the three-level station design option. Should the City of San Francisco select the Main/Beale site for a new bus terminal, the CalTrain project would need to be closely coordinated with the bus terminal project.

The terminal configuration under the Caltrans property would constrain the length of the possible future Intercity/High Speed Rail platforms to approximately 700 feet. The reduced platform lengths would occur because the lead track for Intercity/High Speed Rail would angle further to the east and require some of the area under the Caltrans property that would remain available in the three-level underground configuration.

Two-Level Underground Terminal at Mission Street - Figures 18 and 19

With all four tracks terminating at Mission Street, this two-level configuration is the least expensive of the Market/Beale terminal design options - $200 million less than the three-level underground station. The four tracks would extend beyond the Beale Street right-of-way, encompassing Pacific Gateway and Caltrans property as in the "staggered" configuration. This option would have similar impacts and opportunities to the staggered option, including the need for close coordination with the City of San Francisco's bus terminal project and the constraints on future Intercity/High Speed Rail platform lengths (700-ft maximum).

This design option would have the least impact on vehicle and pedestrian circulation, especially in the heavily congested area between Market and Mission Streets. It would also allow underground structures located on Beale between Market and Mission to remain undisturbed, reducing the impacts on businesses in this area.

This design option would have the least favorable connection with the Embarcadero Station since no tracks terminate at Market. An underground pedestrian concourse with

moving sidewalks would extend the 650 feet between Mission and Market to compensate for the lack of a direct connection, and would connect to the mezzanine at the Embarcadero Station.

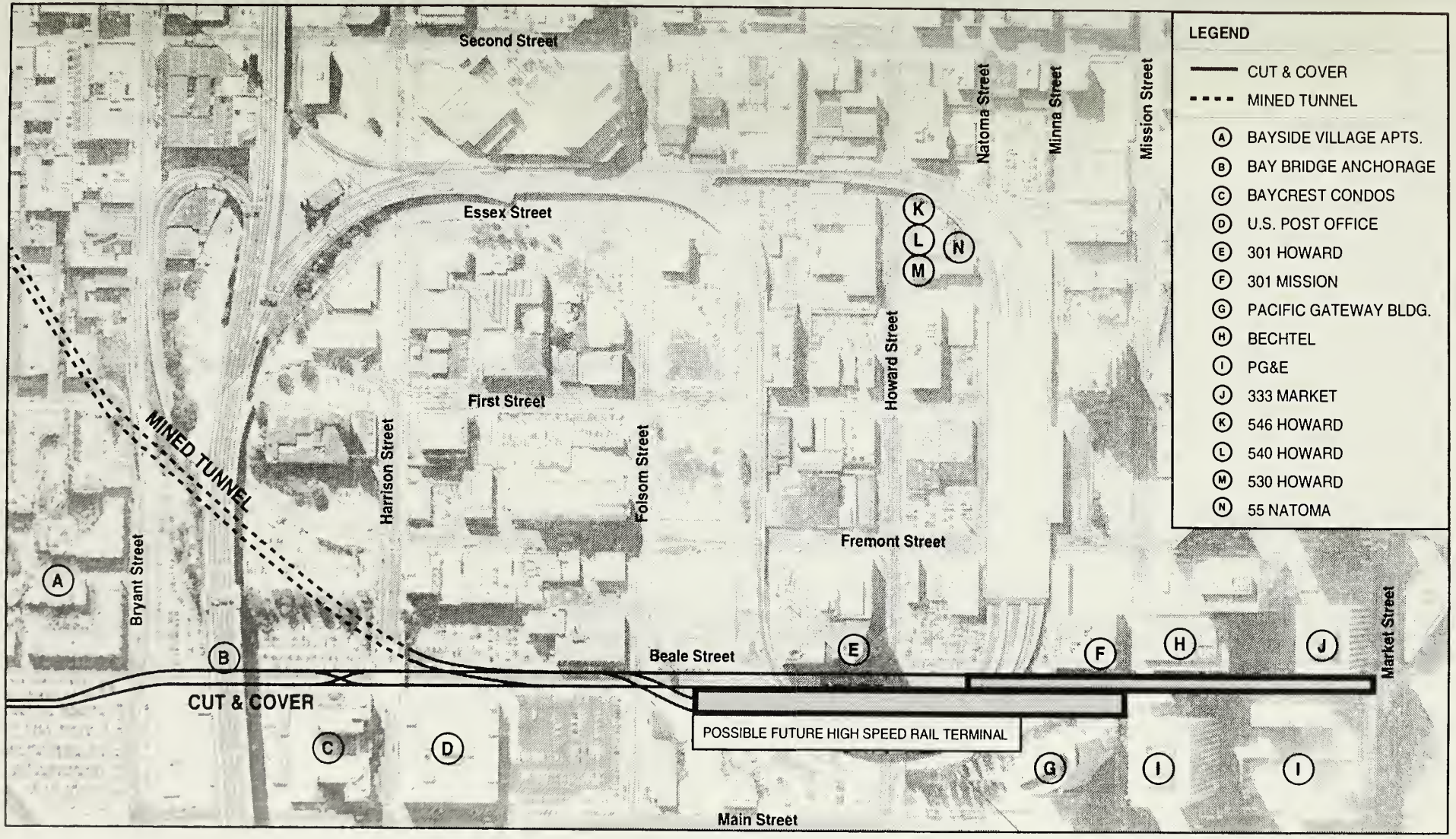

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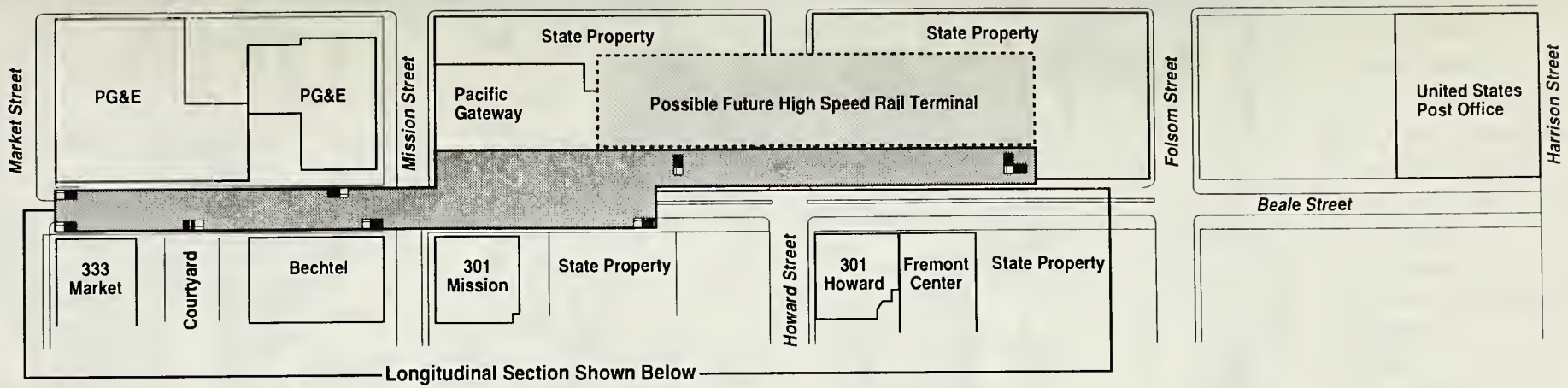
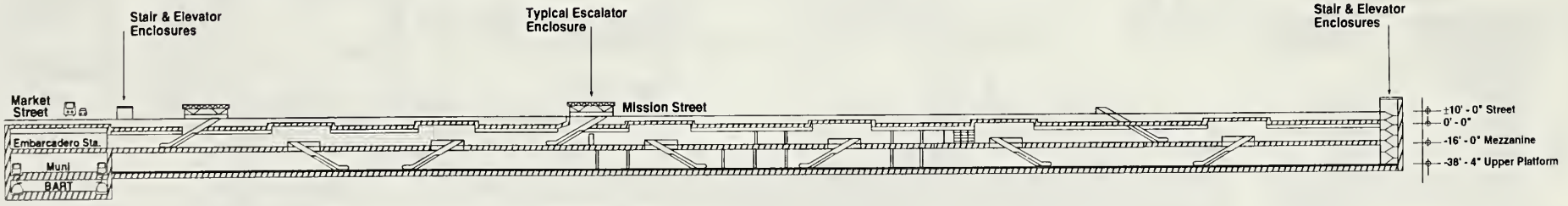
FIGURE 16

MARKET/BEALE ALTERNATIVE:
TERMINAL CONFIGURATION OPTIONS
TWO-LEVEL UNDERGROUND (STAGGERED) AT MARKET AND MISSION STREETS

ICF KAISER/DELEUW

J95.068 fig 16 Mc4





Schematic Not to Scale

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FIGURE 17

MARKET/BEALE ALTERNATIVE:
TERMINAL AREA AND LONGITUDINAL SECTION
TWO-LEVEL UNDERGROUND (STAGGERED) AT MARKET AND MISSION STREETS

ICF KAISER/DELEUW

J95-068 fig 17 M:4

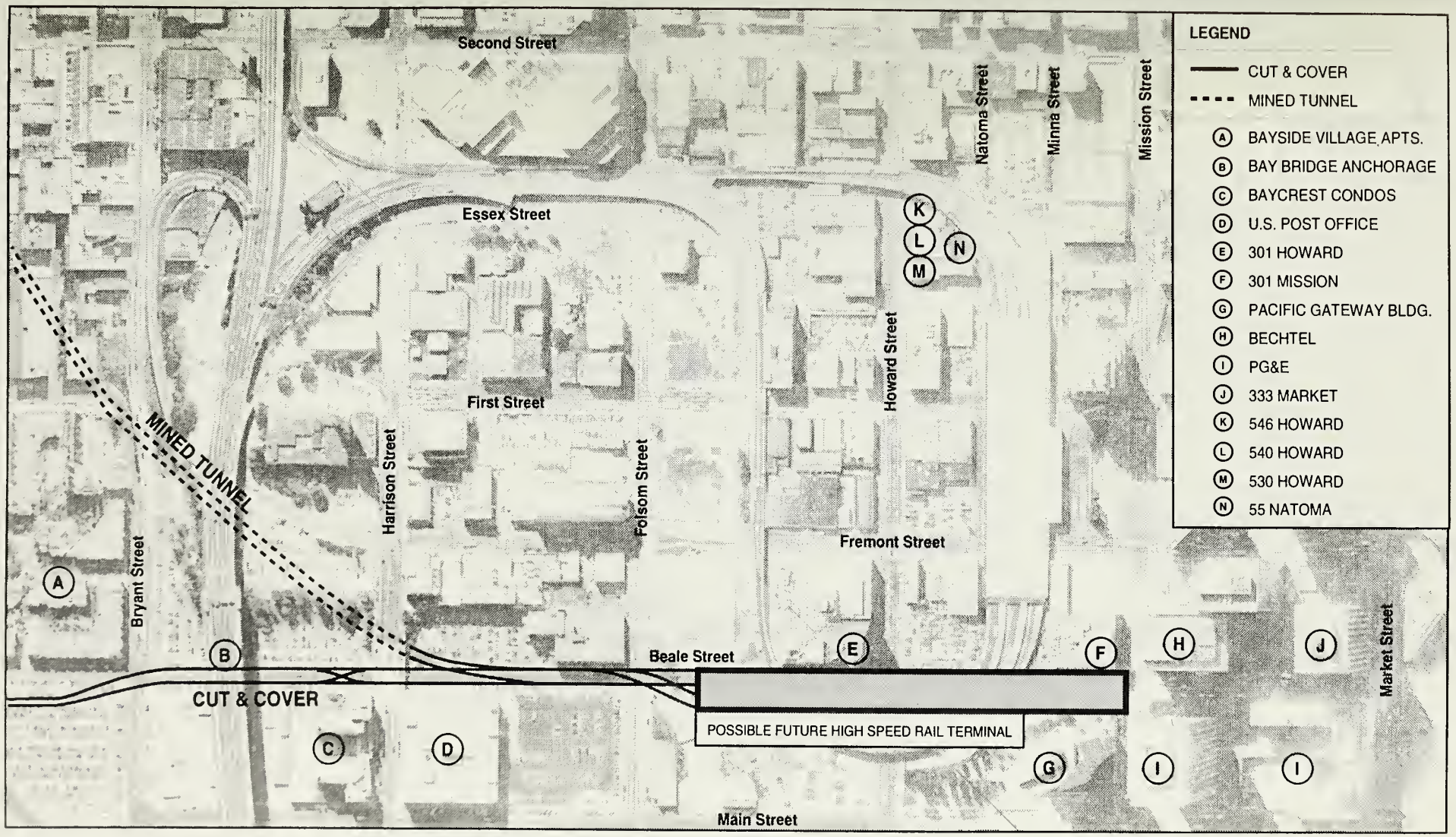

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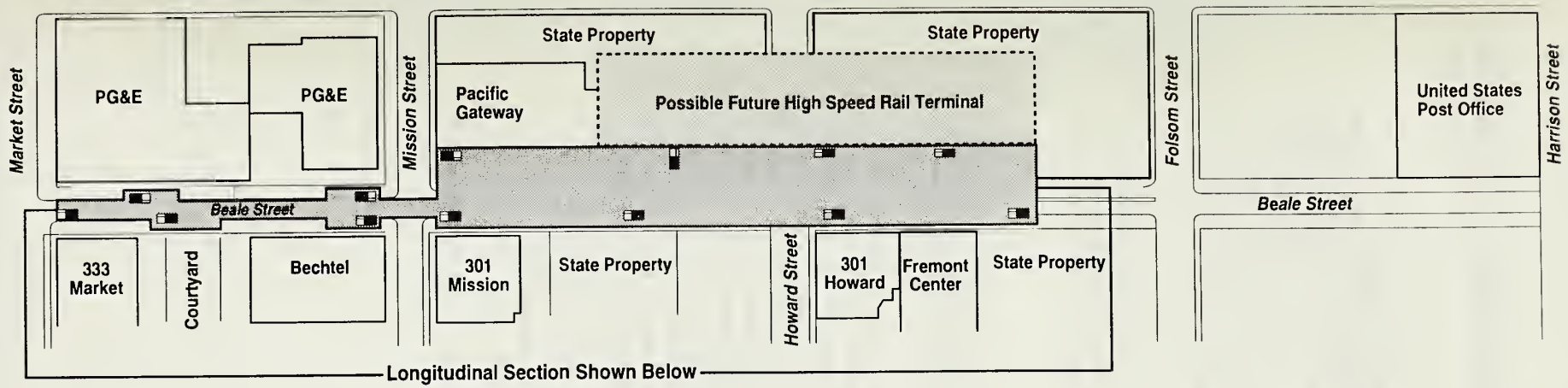
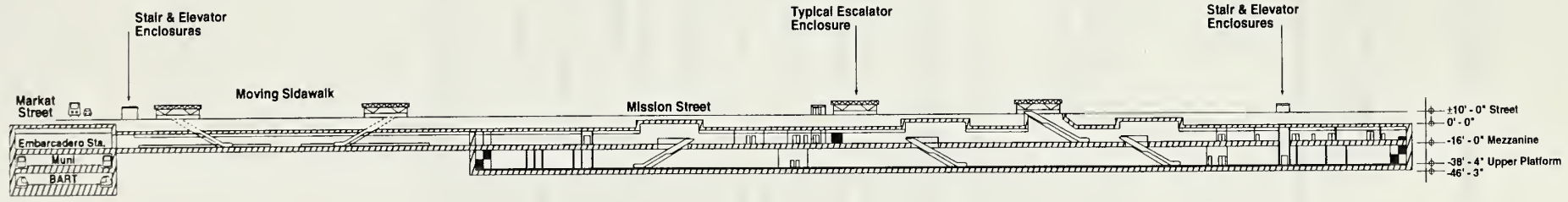
FIGURE 18
MARKET/BEALE ALTERNATIVE:
TERMINAL CONFIGURATION OPTIONS
TWO-LEVEL UNDERGROUND AT MISSION STREET

◆ ICF KAISER/DELEUW

J95-068 fig 18 Mc4





Schematic Not to Scale

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FIGURE 19

MARKET/BEALE ALTERNATIVE: TERMINAL AREA AND LONGITUDINAL SECTION TWO-LEVEL UNDERGROUND AT MISSION STREET

◆ ICF KAISER/DELEUW

J95 068 fig 19 Mc4

DECISION #5: Which Transbay Terminal Site Configuration Option Should Be Selected?

TABLE 8: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #5

Major Construction Impacts	
Transbay Aerial	***Transbay Underground***
• Lowest capital cost of all of the terminal design options at about $470 million. (Townsend/Fifth St. portal, "clean" diesel propulsion)	• Capital costs would be about $65 million more than the aerial terminal option
• Disruption to neighboring businesses during construction from traffic, noise, vibration, and dust • Requires demolition of existing Transbay Terminal and construction of interim or permanent bus facility	• Disruption to neighboring businesses during construction from traffic, noise, vibration, and dust • Requires demolition of existing Transbay Terminal and construction of interim or permanent bus facility
Long Term Benefits/Impacts	
Transbay Aerial	***Transbay Underground***
• Does not offer direct connection with BART/ Muni Metro; underground concourse with 950 ft. moving sidewalk to Market Street • Restricts joint development opportunities since more space used for buses/rail • Possible future Intercity/High Speed Rail terminal would have to extend over Natoma Street • Greater noise and vibration from CalTrain operations above-ground on aerial structures • Visual impacts more severe because of increased height and bulk of new above-ground CalTrain terminal (100 ft. high and 1,350 ft. long) • Requires closure of Tehama and Clementina Streets west of First Street • Requires four properties, 55 Natoma, 530 Howard, 540 Howard, and 546 Howard	• Does not offer a direct connection with BART/Muni Metro: underground concourse with 950 ft. moving sidewalk to Market Street • Provides greater joint development opportunities • Possible future Intercity/High Speed Rail terminal could extend under Natoma Street • Confines noise and vibration impacts from CalTrain operations to underground areas • Minimizes height and bulk with underground CalTrain station • Requires four properties, 55 Natoma, 530 Howard, 540 Howard, and 546 Howard

Aerial Station at the Transbay Terminal Site - Figures 20 and 21

In this design option the existing Transbay Terminal would be replaced with a new bus and train terminal. Passenger ticketing and retail would be on the ground floor. The CalTrain tracks would be located on the second level about 35 feet above the street level. A partial mezzanine between the second and third levels would facilitate passenger circulation between CalTrain and buses. Buses would be located on the third level about 80 feet above street level. The total height of the terminal building would be about 100-feet, while the total length would be about 1,350 feet. Future Intercity/High Speed Rail platforms would extend on aerial structure over Natoma Street towards Howard Street. A Muni surface bus terminal could be located on street-level between Fremont and Beale Streets.

The new Transbay Terminal constructed under this option would extend about 400 feet further east than the footprint of the existing Transbay Terminal, crossing First, Fremont, and Beale Streets right up to the Pacific Gateway Building.

The terminal building's mass could be monumental. Its height may reduce joint development potential on-site, since little space would be available close to ground level and easy access to floors located above the bus deck level would be difficult to provide. The terminal's 35-foot high street crossings could be designed sensitively as attractive gateways to encourage development further south, instead of the imposing and deadening effect created by the existing low-level street crossings.

A 950-foot underground concourse under Beale Street containing moving sidewalks would connect CalTrain with BART and Muni Metro at the Embarcadero Station.

Demolition of the existing Transbay Terminal and supporting ramp structures and construction of the aerial station would temporarily disrupt neighboring businesses. An interim facility for buses would be needed during construction if buses were to return to the Transbay Terminal site. Tehama and Clementina Streets would be permanently closed between First and Second Streets due to construction of a new aerial ramp for trains transitioning from underground into the terminal. In addition, four properties -- 55 Natoma, 530 Howard, 540 Howard, and 546 Howard -- would need to be acquired for construction of the new aerial structures. New bus ramps from the Bay Bridge to the Transbay Terminal, significantly higher than the existing ramps, would need to be constructed for bus access into the third level, some 80 feet above the street. These taller bus ramp structures could create an adverse visual impact for the surrounding area.

After completion of the facility, long term noise and vibration impacts could occur as a result of train operation on the open-air ramps into the aerial station. Because the trains would be making a sharp turn (approximately 385-feet radius) to enter the new station, the wheels would squeal.

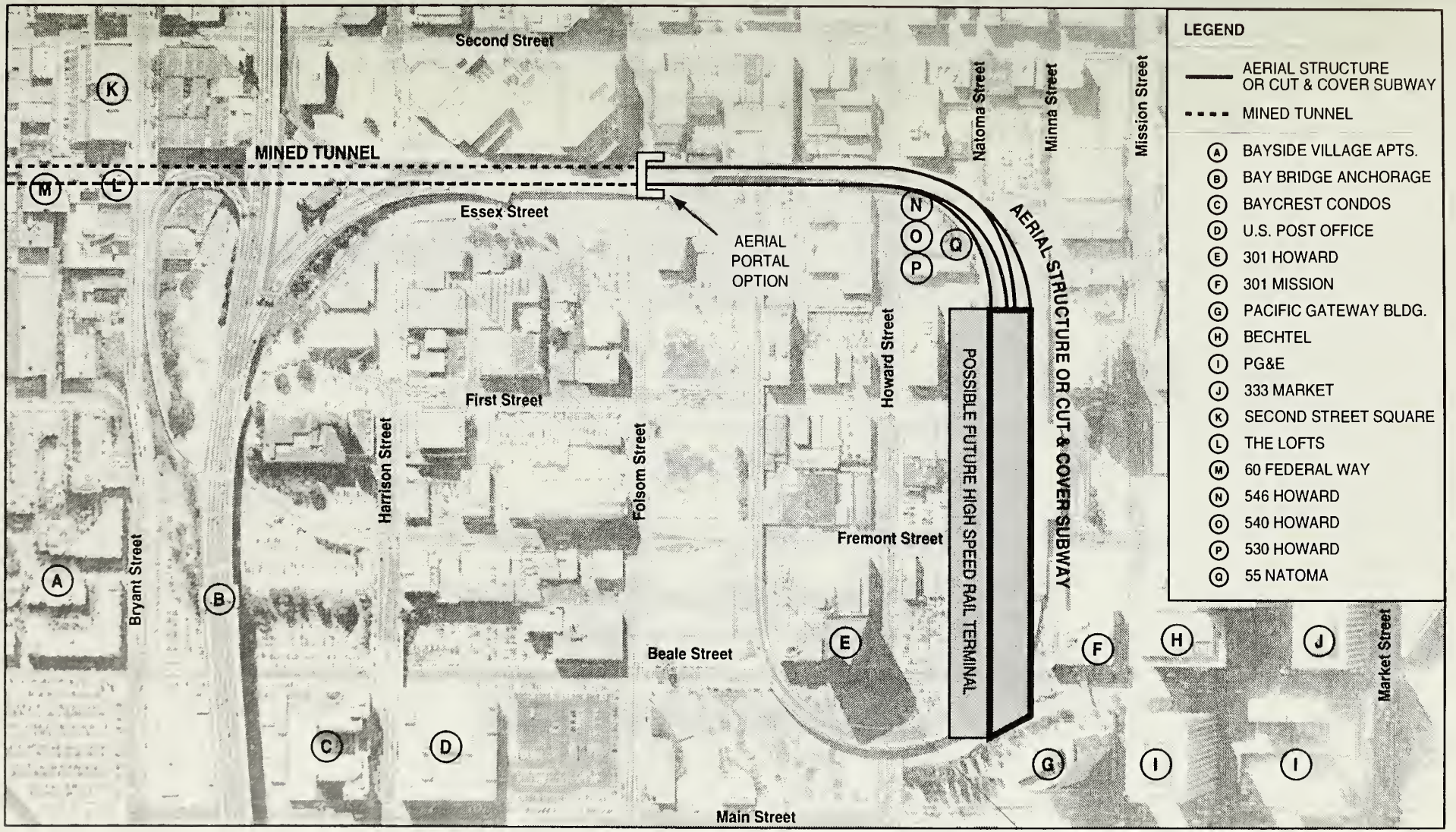

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FIGURE 20

TRANSBAY TERMINAL SITE ALTERNATIVE: AERIAL AND UNDERGROUND TERMINAL DESIGN OPTIONS

ICF KAISER/DELEUW

J95.068 fig 20 Mc4

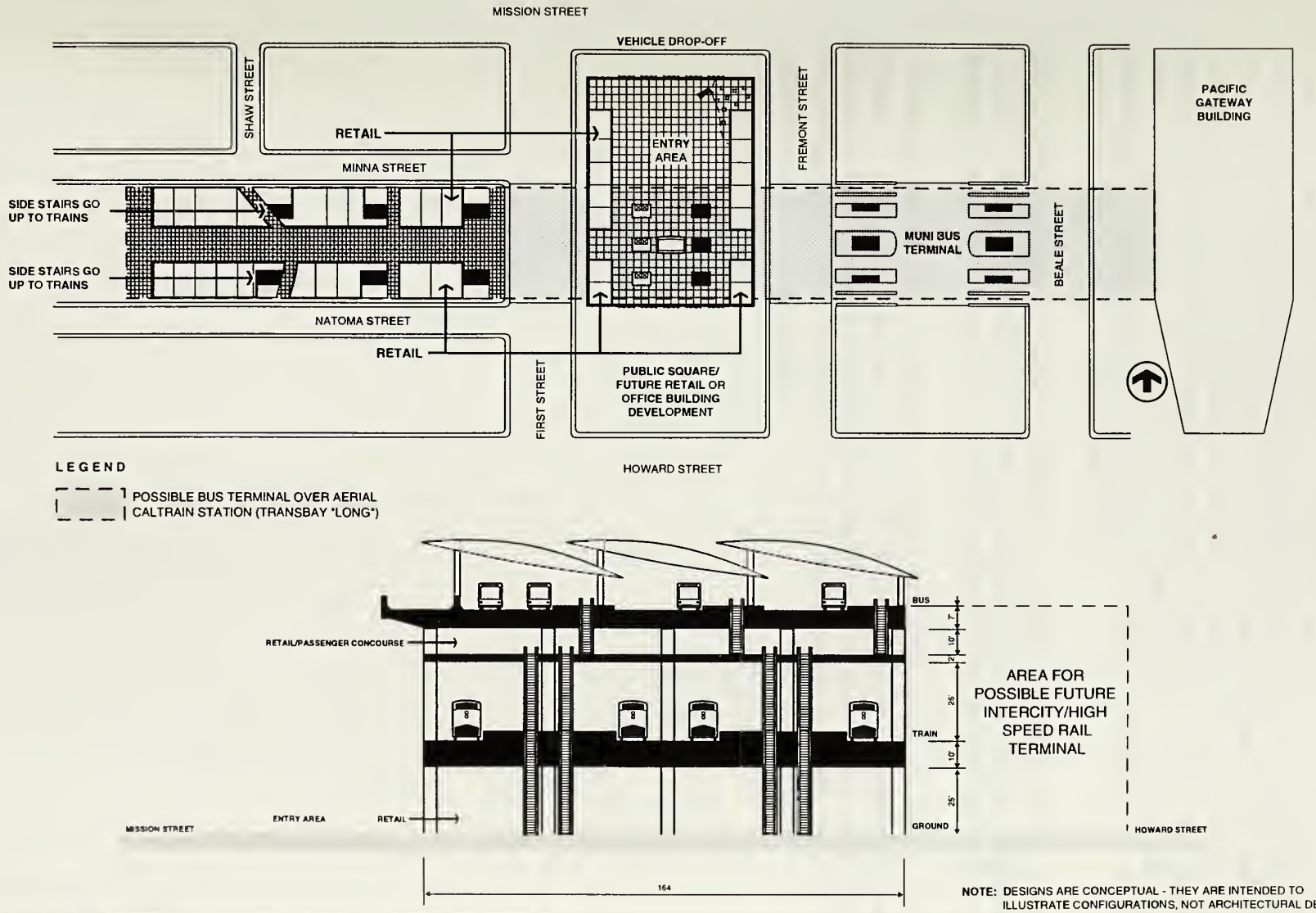

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FIGURE 21

TRANSBAY TERMINAL SITE ALTERNATIVE: TERMINAL AREA AND CROSS SECTION AERIAL TERMINAL CONFIGURATION OPTION

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Underground Station at the Transbay Terminal Site - Figure 22

Under this design option, CalTrain would be located underground with retail and passenger services on the ground level and with buses on the second and third levels. The underground station would have the advantages of significantly lowering the height and bulk of a new terminal facility at this site. Alternatively, if buses were relocated to Main/Beale, CalTrain could terminate at an underground station with passenger services either on the surface (with a canopied plaza entry area) or on the platforms below. In this scenario, the entire length of the existing Transbay Terminal site could be used as public open space or for joint development.

The underground station would incorporate a 950-foot underground concourse connecting CalTrain with BART/Muni Metro at the Embarcadero Station. A Muni surface bus terminal could be designed on the block between Fremont and Beale Streets.

Nearby businesses would experience temporary traffic, noise, vibration, and air quality impacts. Long term noise and vibration impacts would be less intrusive than the aerial terminal option by being confined to an underground area. Like the aerial option above, four properties -- 55 Natoma, 530 Howard, 540 Howard, and 546 Howard -- would be acquired for this design option.

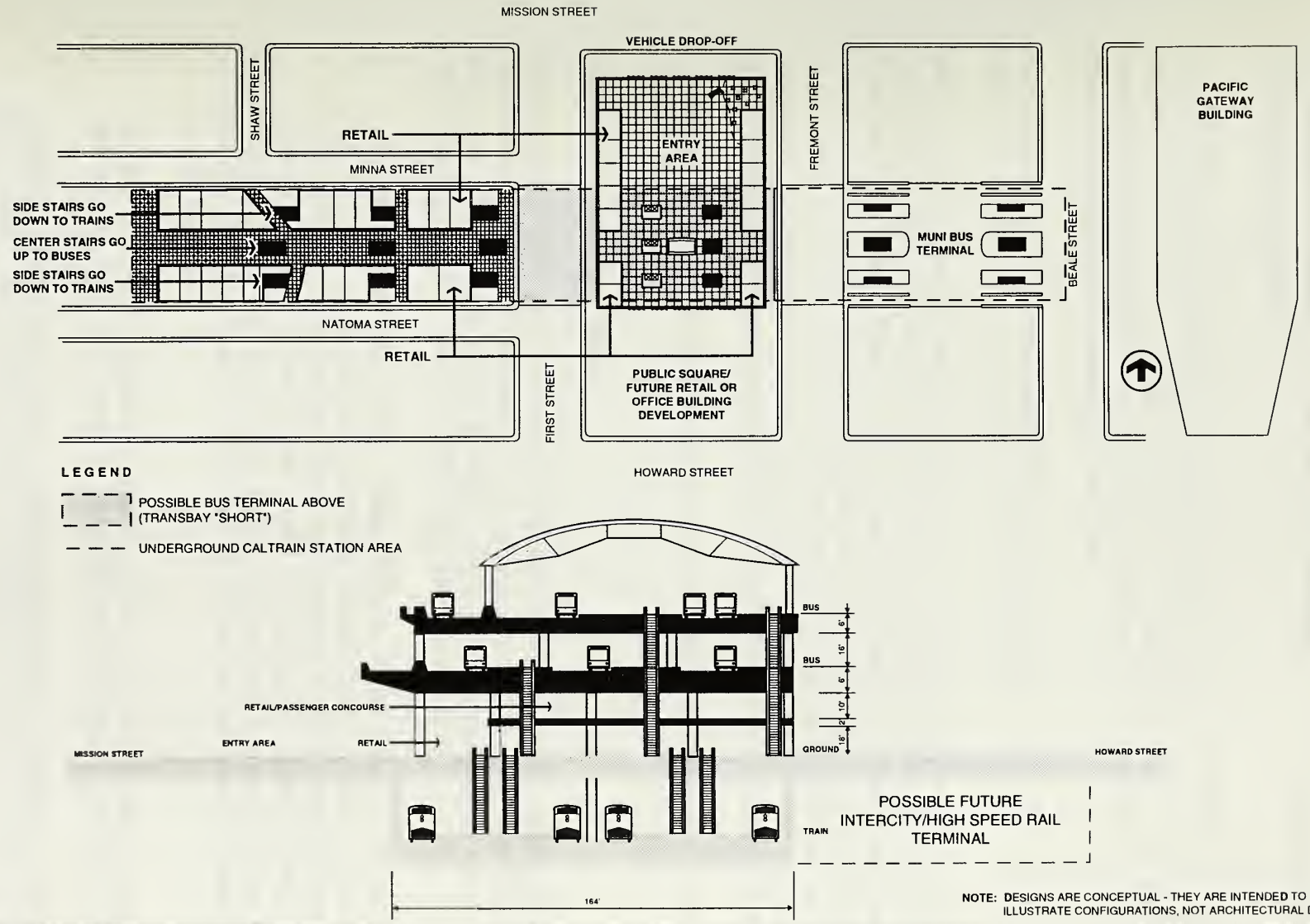

FIGURE 22

TRANSBAY TERMINAL SITE ALTERNATIVE: TERMINAL AREA AND CROSS SECTION UNDERGROUND TERMINAL CONFIGURATION OPTION

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DECISION #6: Should The Market/Beale Alternative or the Transbay Terminal Site Alternative Be Selected?

The purpose of this document is to provide the information necessary for the public and decision-makers to assist them in selecting design options to optimize the Market/Beale and the Transbay Terminal Site alternatives. In previous sections, the design options particular to each of the alternatives have been summarized and the reader has developed an "optimized" alternative for each site.

At this point, it is useful to compare the two "optimized" alternatives to see if a preference for one of the two terminal sites can be identified.

While this document is being prepared for the CalTrain San Francisco Downtown Extension Project, the project is closely linked to the City of San Francisco's Transbay Terminal Area Study. One purpose of the City's study is to determine a location for a new transit hub in the Transbay Terminal area for buses (and potentially trains). Decision #6 is designed to assist the City in presenting the options for bus and train stations in the Transbay Terminal area. The City will use information in this report to help recommend preferred location(s) for the CalTrain station and the new bus terminal.

The following section outlines the five major CalTrain/bus terminal options under consideration.

CalTrain/Bus Terminal Options

There are five basic combinations of CalTrain and bus terminal options that are currently under consideration. A document that presents views of the five schemes is being developed. These views will be available at the public presentations and the document will be available by late October 1995. The five options are:

A. **CalTrain: Market-Beale—Bus: Main-Beale —** In this option CalTrain would be in one of the three Market/Beale terminal designs (see Decision #4) and buses would be located in a new bus terminal located between Main and Beale Streets north and south of Howard. Direct access would be provided for buses to/from the Bay Bridge. In one variation of this option, no new bus terminal building would be built; instead, buses would utilize a surface bus lot and would access the site via surface streets.

B. **CalTrain: Transbay Terminal (Aerial)—Bus: Transbay Terminal (Long) —** This option is the CalTrain Transbay Terminal Aerial Option (see Decision #5).

C. **CalTrain: Transbay Terminal (Underground)—Bus: Transbay Terminal (Short) —** This option is the CalTrain Transbay Terminal Underground Option (see Decision #5).

D. **CalTrain: Transbay Terminal (Underground)—Bus: Transbay Terminal (Medium)** — This option is similar to the CalTrain Transbay Terminal Underground Option except that a larger bus terminal building would be built. The advantage of this bus terminal is that it would allow improved operation of buses and a much-improved passenger waiting environment.

E. **CalTrain: Transbay Terminal (Underground)—Bus: Main-Beale** — This alternative would combine an underground CalTrain station on the site of the existing Transbay Terminal with a new bus terminal on the Main/Beale site. The east end of the CalTrain terminal would intersect the north end of the bus terminal and both would be linked to the Embarcadero BART/Muni Metro Station via an underground concourse with a moving sidewalk. A significant new South of Market park could be built on all or part of the site vacated by the existing Transbay Terminal (with CalTrain underneath). One advantage of this option is that the Main-Beale bus terminal could be built before the existing Transbay Terminal was demolished, so no temporary bus facility would be needed during construction of the new CalTrain terminal.

Table 9 summarizes costs and issues surrounding each of the five major CalTrain - Bus Options.

TABLE 9: Summary of CalTrain/Bus Terminal Options

Option	*Capital Cost ($Millions)**	*Notes*
A. CalTrain: Market-Beale- Bus: Main-Beale	Train $540-745 Bus $150	• Current locally preferred alternative • Highest cost train facilities • No interim bus facilities needed
B. CalTrain: Transbay Terminal (Aerial)- Bus. Long	Train $470-480 Bus $100	• Interim bus facility needed • Very large above-ground structure • Island bus boarding platforms
C. CaTtrain: Transbay Terminal (Underground)- Bus: Short	Train $535-545 Bus $100	• Interim bus facility needed • Smallest structure • Island bus boarding platforms
D. CalTrain: Transbay Terminal (Underground)- Bus: Medium	Train $535-545 Bus $120	• Interim bus facility needed • Better bus operations and much better passenger amenities
E. CalTrain: Transbay Terminal (Underground)- Bus: Main/Beale	Train $535-545 Bus $150	• No interim bus facility needed • Opportunity for major open space or joint development above CalTrain station

*CalTrain capital cost(s) shown here assume the Townsend Street Alignment/Fifth Street portal and "clean" diesel locomotive propulsion options. CalTrain electrification would cost an additional estimated $210 million. The bus capital costs are order-of-magnitude only; more definitive estimates will be available in mid-October from the City's TAPP study consultant.

DECISION #7: Which Locomotive Propulsion Option Should Be Selected? (Figure 23)

TABLE 10: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #7

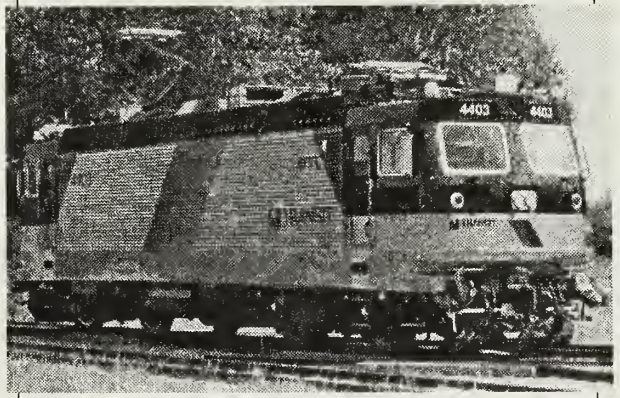
Benefits/Impacts			
"Clean" Diesel	***LNG***	***Electrification***	***Dual-Mode***
• Lowest capital cost (tied with LNG)	• Lowest capital cost (tied with "clean" diesel)	• Highest capital cost - about $210 million more than diesel or LNG	• High capital cost - about $150 million more than diesel or LNG.
• Technology needs to be further developed with R&D program • Greatest nitrogen oxide emissions • 50-foot high exhaust shafts would be required in two locations to properly ventilate the underground station areas • About 90 vent shafts would be required to ventilate the tunnel along the alignment	• Technology needs to be further developed with R&D program • Reduces nitrogen oxide emissions by two-thirds over diesel propulsion • Safety issues (LNG has a temperature of 200 degrees below zero and can be a fire hazard because of its volatility) • About 22 vent shafts would be required to ventilate the tunnel along the alignment • Locomotive range between refuelings would be reduced by about 60% to about 240 miles due to LNG fuel and tank requirements	• Must replace all locomotives • Visual impact of overhead wire and substations • Electro-magnetic fields • Least air polluting • Least noise impacts • Slightly faster train travel times possible • About 16 vent shafts would be required to ventilate the tunnel along the alignment	• Must replace all locomotives • No "off-the-shelf" locomotives are currently available which will operate dual mode on 25 kVA AC power • New dual mode locomotives would be needed to convert 25 kVA AC power to 600 volt DC power, so that the locomotive could be kept for later full system electrification. These locomotives would involve a major R&D effort. • About 16 vent shafts would be required to ventilate the tunnel along the alignment

"Clean" Diesel

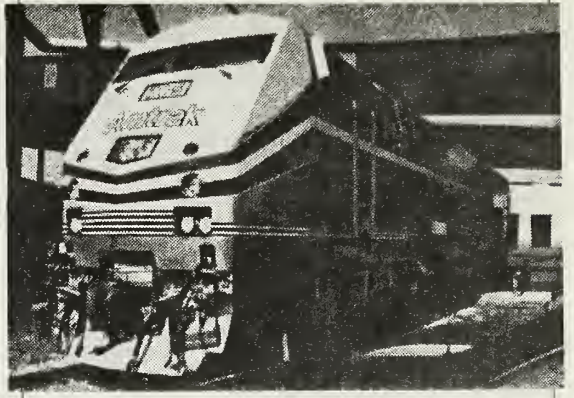
"Clean" diesel refers to a retrofit diesel engine that incorporates new technology to reduce diesel air pollutants. The retrofit engine, in combination with an extensive ventilation system, could permit diesel locomotives to operate in a tunnel and underground passenger station environment without exceeding health standards for clean air. "Clean" diesel, along with LNG, represent the least-cost locomotive propulsion/ventilation system options that can operate in the CalTrain downtown San Francisco extension.

In spite of the reduction in pollutant emissions, "clean" diesel locomotives discharge the highest level of nitrogen oxides, as well as carbon monoxide, formaldehyde, and particulate matter, of the four propulsion options. The ventilation system needed to remove pollutants in the tunnel would require 200-square-foot ventilation ducts on average every 200 feet along the alignment. These ducts can be grouped together and placed at longer intervals if need be to minimize adverse impacts on existing landuses. These

Diesel or Liquefied Natural Gas Propulsion



Electric Propulsion



Dual-Mode (Diesel/Electric) Propulsion

FIGURE 23
LOCOMOTIVE PROPULSION OPTIONS

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approximately 90 ducts would have to be placed away from residential structures and pedestrian walkways. In congested areas surrounding the underground terminal stations. about 50-foot high ventilation stacks would be required and attached to adjacent buildings to ensure that the diesel locomotive pollutants are released well-above street level. Two ventilation stacks, one at each end of the terminal station, would be required. An aerial station would require ventilation stacks that would carry the pollutants above the train and bus levels to the roof-top.

Liquefied Natural Gas (LNG)

LNG propulsion, which has recently been employed on freight locomotives in surface operations, could reduce the level of nitrogen oxides by two-thirds over diesel propulsion. LNG would be stored in heavily-insulated tanks on-board the retrofitted locomotives. For the CalTrain system, one tank of LNG could be expected to power a locomotive for only one day's trips (about 240 miles). All existing CalTrain diesel locomotives would be converted to LNG and corresponding LNG fueling facilities would be installed. The cost of conversion would be about the same as "clean" diesel, but would be substantially below the cost of full system electrification.

LNG has a greater safety risk than diesel or electric propulsion. The gas is stored at about minus 200 degrees Fahrenheit. If released unexpectedly in an underground area. it would quickly vaporize and, without proper dispersal, collect on the ceiling of the enclosed area. Proper ventilation and a natural gas detector system located along the ceiling of the underground station area and tunnel would be necessary to minimize the possibility of vaporized LNG exploding. Approximately 22 200-square-foot ventilation ducts would be spaced about 800 feet apart.

System Electrification

Electrification of the entire CalTrain system is the most expensive propulsion option due to the cost of overhead wire installation, substation construction, a new communications system, and replacement of all locomotives. The total cost would be about $230 million.

The added cost would be compensated for by several advantages. For example, electrification is a proven propulsion system, used worldwide by rail systems with similar operating characteristics to CalTrain. It would offer a nearly pollution-free system that would not require the extensive ventilation system mandatory for diesel or LNG operation in subway and underground stations. For electric operation in subway, 200-square-foot ventilation ducts could be spaced every 1,000 feet. Additionally, electric propulsion would reduce the level of noise produced by locomotives operating on the surface or underground. The acceleration characteristics of electric locomotives are superior to other modes and, as a result, could provide a small reduction in train running times.

Dual-Mode Propulsion

Dual-mode locomotives can operate either with diesel or electric propulsion. With this propulsion option, CalTrain could operate using diesel fuel on the surface and switch to electric propulsion before the train entered the downtown subway. The advantages of electric locomotives, in terms of reducing air pollution, ventilation requirements and noise in underground areas, could be gained without incurring the added cost of installing substations and overhead wire throughout the entire 77-mile CalTrain system. Currently, there are no "off-the-shelf" 25 kVA dual-mode locomotives. Existing dual-mode locomotives, as employed at Grand Central Station in New York City, draw electricity from a third rail once in the subway. The third rail 600 volt DC power is used directly by the locomotive.

Under this option, it is assumed that the existing diesel locomotives would be replaced with 25 kVA dual- mode locomotives. It would require a major engineering effort to develop such a specialized dual-mode locomotive, and they would likely cost more than $7 million each. The cost of this option is approximately $170 million or about 75 percent of the cost of full system electrification (at about $230 million). If full system electrification were implemented later on in the future, an additional $120 million would be required to electrify the line from 16th Street to Gilroy (total cost $290 million). Thus the cost of converting from dual-mode to full electrification would be approximately $60 million more than simply constructing full electrification today.

DECISION #8: Where Should A New CalTrain Storage Yard Be Located?

TABLE 11: SUMMARY OF BENEFITS & IMPACTS FOR DECISION #8

Benefits/Impacts	
16th Street/I-280	***Brisbane***
• Capital costs estimated to be $13.5 million • Least deadhead time and lowest operating cost • Compatible with Mission Bay Plan land use designation for this site • Possible noise and visual impacts to proposed development in Mission Bay • Site is currently occupied by a major warehouse	• Capital costs estimated to be $9.5 million • Three and a half times longer deadhead times, higher operating costs ($0.5 million per year more) • Master plan for this area is under development • Site is currently vacant/undeveloped

Currently, the CalTrain station area at Fourth and Townsend has twelve tracks available for the arrival and departure of trains. Twelve tracks allow the boarding and disembarking of passengers to occur simultaneously without affecting turnaround time of the trains. Several tracks can be used for extended layovers without impeding CalTrain operations.

In the scenarios that incorporate a new terminal either at Market/Beale or at the Transbay Terminal site, four tracks would be assigned to CalTrain. Although additional tracks could be installed for Intercity/High Speed Rail at a future date, space limitations, and the high costs of underground construction preclude additional tracks at either terminal location for CalTrain operation. The CalTrain operating plan (2010) would require all four tracks be used for arriving and departing trains. Consequently, trains could not be "stored" in the station area, as is currently the case.

A new train storage area would be developed to accommodate the CalTrain operating plan for the downtown terminal. Two sites are being evaluated. One is in Mission Bay at 16th and Owens Street east of the I-280 viaduct and the existing CalTrain alignment. The other is near the former Bayshore Yard in Brisbane - See Figure 24.

MISSION BAY STORAGE YARD - Figure 25

The proposed CalTrain storage yard in Mission Bay would have eight tracks extending from Hubbell to 16th Street and three lead tracks linking the storage area with the CalTrain mainline from the north and south. If the portal location south of Berry were selected, the lead track and turnouts would be within the inclined U-wall section of the portal. For the other portal locations, the lead track and turnout would occur at grade. The deadhead time from the downtown terminal to this storage area would be approximately 13 minutes, adding about $1.4 million (about 2 percent) to CalTrain's annual operating costs.

In this scenario, the alignment reservation for the proposed Muni Metro extension through Mission Bay would be shifted to within 150 feet of Owens Street. The location of the CalTrain storage yard conforms with the currently approved land use plan for

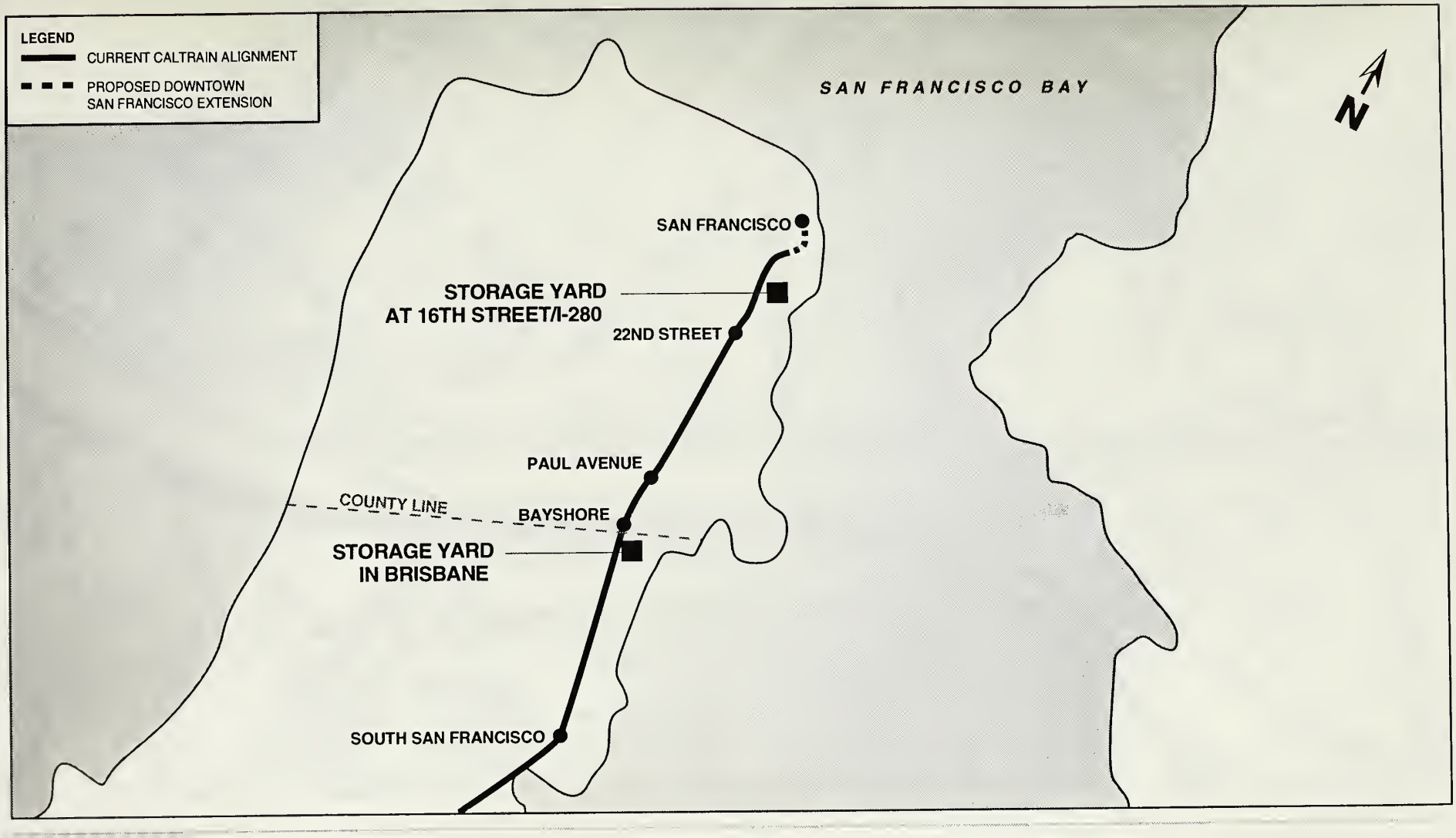

FIGURE 24
POTENTIAL CALTRAIN STORAGE YARD LOCATIONS

CALTRAIN SAN FRANCISCO DOWNTOWN EXTENSION PROJECT

PENINSULA CORRIDOR JOINT POWERS BOARD

◆ICF KAISER/DELEUW

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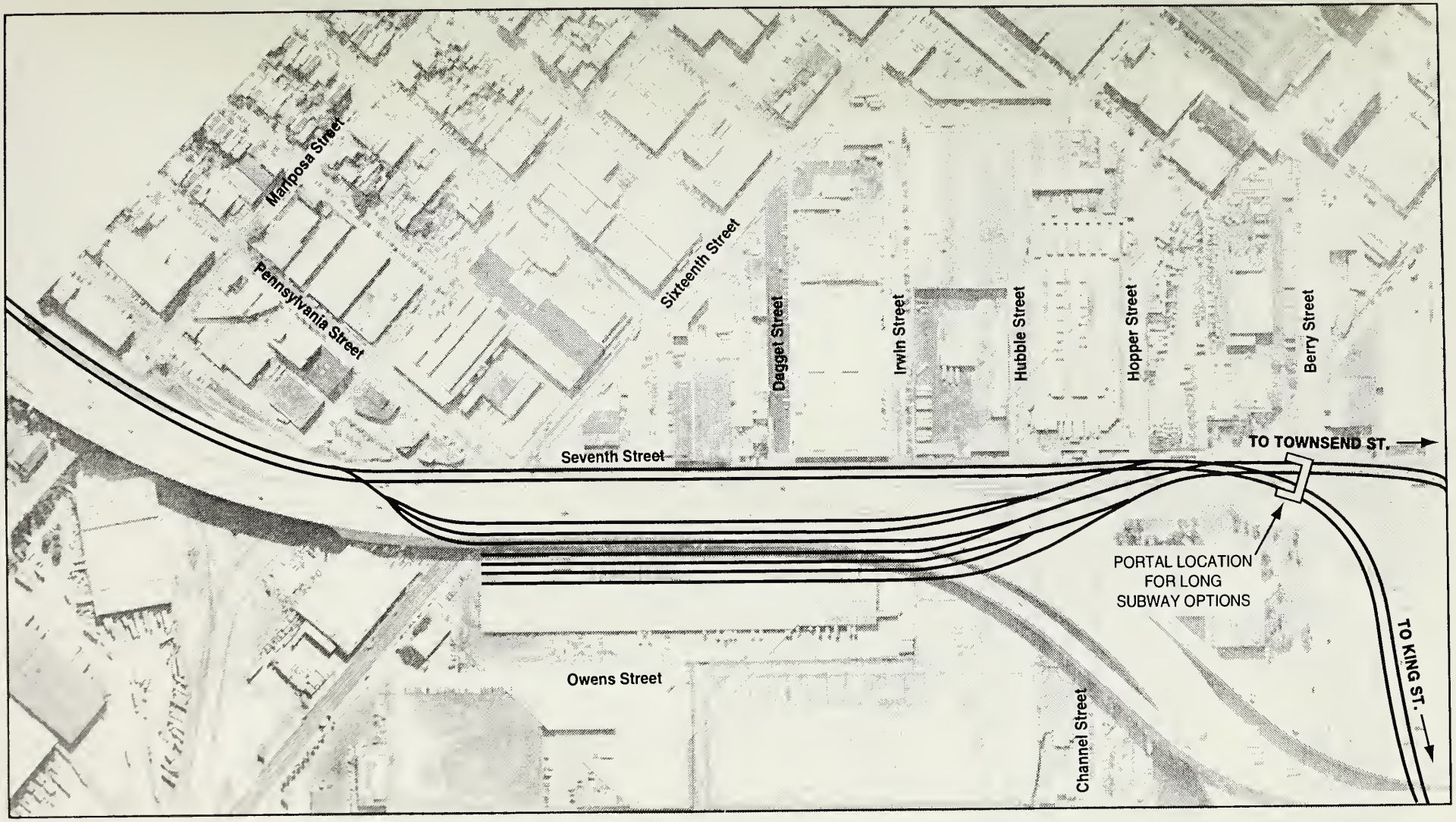

FIGURE 25

16TH STREET/I-280 (MISSION BAY)
STORAGE YARD LOCATION AND CONFIGURATION

CALTRAIN SAN FRANCISCO
DOWNTOWN EXTENSION PROJECT

PENINSULA CORRIDOR JOINT POWERS BOARD

ICF KAISER/DELEUW

J95-068 fig 25 Mc4

Mission Bay. However, by shifting the Muni Metro alignment to the east, the proposed land uses west of Owens Street would be confined to a narrow strip of land along Owens. This strip could be used as a buffer between the proposed transportation uses and the future development along the east side of Owens.

Brisbane (Bayshore Yard) Storage Yard - Figure 26

The potential CalTrain storage yard in Brisbane would be located between the CalTrain mainline tracks and Tunnel Avenue, immediately south of the San Francisco/San Mateo County line. The storage yard, which would have lead tracks from the north and the south, would contain four storage tracks over 2,000 feet long. The deadhead time from the storage yard to the downtown terminal would be about 20 minutes, adding about $1.9 million (about 3 percent) to CalTrain's annual operating costs. Thus this yard site would add approximately $0.5 million over the Mission Bay Yard site to CalTrain's annual operating costs. A Master Plan for the area surrounding the proposed storage yard is currently being formulated by Tuntex, Inc.

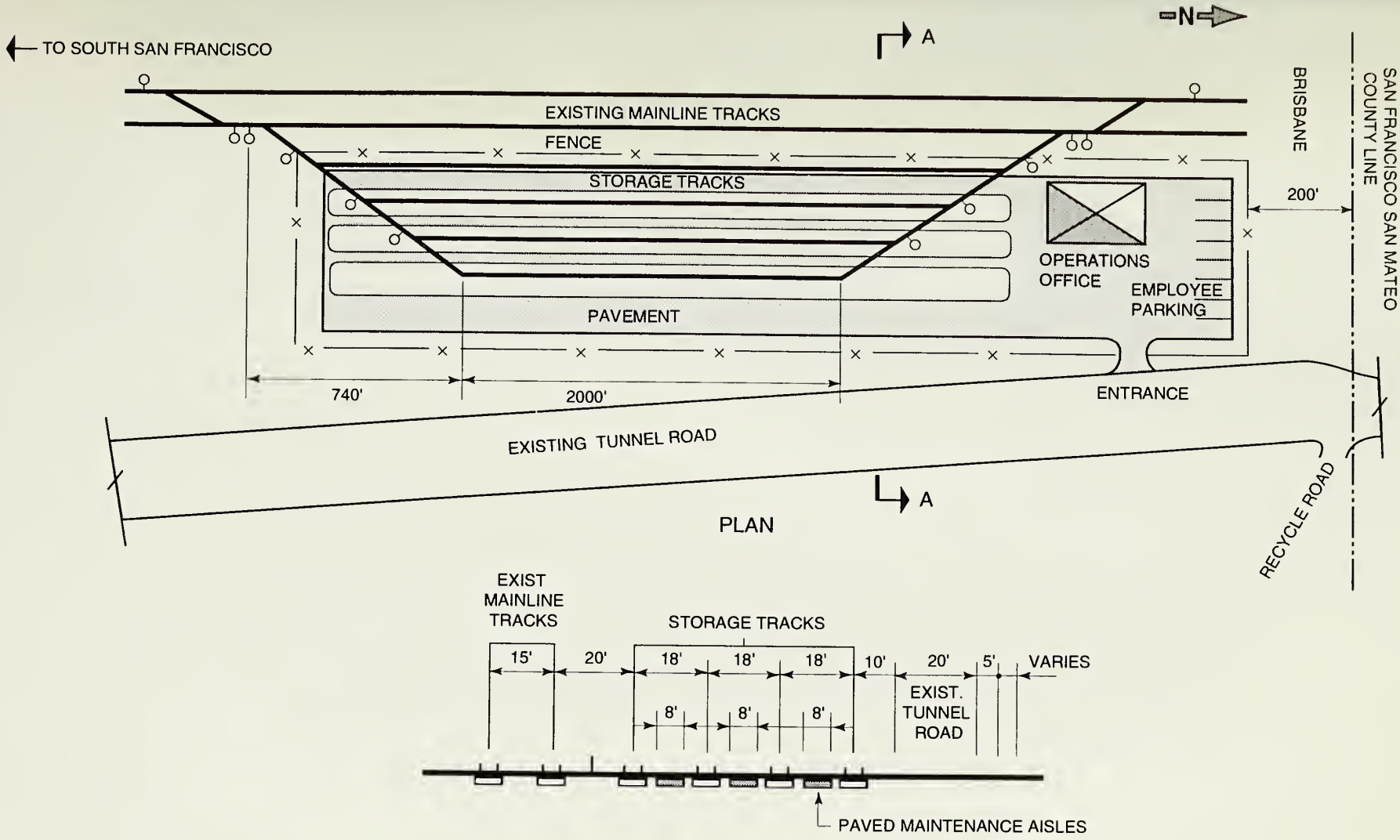

FIGURE 26

BRISBANE (BAYSHORE)
STORAGE YARD LOCATION AND CONFIGURATION

CALTRAIN SAN FRANCISCO
DOWNTOWN EXTENSION PROJECT

PENINSULA CORRIDOR JOINT POWERS BOARD

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